Concrete

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How to Design a Concrete Mix

Reason for Designed Mixes—Determining the Amount of Water—What Slump to Use—Fineness Modulus Defined—An Easy Way to Determine Fineness Modulus and Work Out the Nominal Mix—The "Field Mix"—Final Precautions

A GREAT deal of material has been published on the proper design of concrete mixes, but most of it has been either directed to the man with engineering training, or to the man who is simply expected to carry out orders. Very little has been written on the subject that is suitable for the use of the concretor who is not a trained technician, but who nevertheless has his own problems to work out, and who doesn't care to incur the loss involved in following rule-of-thumb methods. It is for such men that this article has been prepared, and they should find it a really practical guide to the design of concrete mixes.

Good concrete can be made by very rough methods, of course. But to do it that way means a richer mix, and consequently a more expensive one, than a well designed mix which would give the same strength concrete. Now that the water-cement ratio theory has been developed, it is possible to make a very good and fairly economical concrete by simply keeping a close control on the amount of water that is used with each bag of cement. But if maximum strength is wanted with the very minimum amount of cement, a mix must be used which takes into account the various things that influence the workability and proportions of a mix which is intended to give concrete of a certain definite strength. Only in this way can a mix be obtained which gives the strength and uniformity desired, and does it at the lowest possible cost per cubic yard. For that reason it is well worth your while to master the steps outlined in this article if your work is such that the saving of a fraction of a bag of cement on each batch is of real importance to you.

The First Step—The Amount of Mixing Water

The first and simplest determination to be made in designing a concrete mix is that of the water-cement ratio. This is most easily expressed in terms of the amount of water to be used with each sack of cement. This amount of water *(less whatever water may be contained in the sand and gravel used with one sack of cement)*, is the amount that should go into the mixer for each one-bag mix. A two-bag mix would take double that amount; a three-bag mix, three times, etc.

The amount of water may be taken direct from the following table. You will note that for each strength, two different amounts of water are mentioned. The larger amount is the greatest quantity of water that can be used under favorable conditions and still give the required strength. The smaller amount is the quantity of water that may be depended upon to give concrete of the desired strength under ordinary job conditions. It is better to use an amount of water that is close to the smallest quantity, rather than the largest. It is safer.

TABLE 1

Strength Desired, Lbs.	Gallons of Water Per Sack of Cement
2000	6¾ to 7½
2500	6 to 6¾
3000	5¼ to 6
3500	4¾ to 5¼
4000	4¼ to 4⅞
4500	4 to 4½
5000	3½ to 4

The use of this table explains itself. Simply take off the amount of water opposite the strength desired. For instance, to get 3000-pound concrete, use from 5¼ to 6 gallons of water per sack of cement; and to be on the safe side, stick as close as you can to the 5¼ gallons. That gives you a safety margin of about 500 pounds compressive strength, which should be ample under ordinary field conditions.

In actual use, the amount of water taken from the table should be reduced by the amount of water in the aggregates. In other words, the quantity of water you actually put into the mixer with each sack of cement in order to get 3000-pound concrete should be a little less than the amount taken from the table in order to allow for water already in the sand and gravel you are using. How much less is shown in the following table:

TABLE 2

	Mix		
Condition of Aggregates	1:2:3 Gal.	1:2:4 Gal.	1:3:6 Gal.
Practically Dry	½	½	¾
Damp	1½	1¾	2½
Wet	3¼	3½	5¼

The figures shown are gallons of water contained in the total aggregates of a one-bag mix of the types specified. Thus if the mix you use with 5¼ gallons of water to get 3000-pound concrete is approximately 1:2:4; and your aggregates are damp, as most washed aggregates are when used, you will actually add to each one-bag batch only 3½ gallons of water to get the total of 5¼ gallons actually needed in the batch to obtain the kind of concrete you are planning for. Should this quantity of water seem insufficient, it would be permissible to increase it slightly, *so long as the total amount of water in the aggregates, and water used in mixing, is not greater than the largest quantity permitted by Table 1 for the particular strength desired.*

Trial Mix by Water-Cement Ratio Method

The water-cement ratio being determined in gallons per bag of cement, and corrected for moisture in aggregates, it now remains to select the quantities of large and small aggregates that give the desired kind of concrete. There are two ways of doing this. One way is simply to make a trial mix, using clean, well-graded aggregates in what experience has shown to be about the right proportions for the sort of work in hand. *In the hands of a man experienced in concrete work such a method will not go far wrong.* So long as the water-cement ratio is not altered, there will be little variation in strength, and the experience and interest of the mixer man can be relied upon to produce a fairly good mix—that is, one which employs the greatest possible amount of aggregates to the batch consistent with workability, density, and the determined quantity of water.

In practice a trial mix can be worked out by making a cement paste of proper water-cement ratio and adding to it dry sand and gravel until the proper consistency is attained; the proportions used can then be corrected to field conditions by the method described later in the article under the heading of "The Field Mix." Concrete made in this way will be found to be very satisfactory from practically any standpoint.

A Computed Mix

But if a more definite mix is desirable—and it often is—some further calculations are advisable in order to work it out most economically. The first thing necessary to this end is the determination of the "true mix." To do this, we must know the approximate slump desired, and the sort of aggregates available.

The slump is, of course, determined by the work in hand. In massive structures a very slight slump can often be used to advantage. In ordinary foundation work a slump of 3 to 4 inches is adequate. For thin walls, slabs, and for working in around heavy reinforcing, a slump of 6 to 7 inches is generally desirable. Slumps greater than that are not often necessary or desirable. Provided the quantity of water per bag of cement remains constant, the slump does not affect the strength of the concrete, but it does affect the economy of the mix. In general, the less the slump, the more concrete you will get out of a bag of cement. But in seeking economy, do not make the mistake of using so slight a slump that the extra labor of placing the concrete more than makes up for your saving on the mix.

Having decided upon the slump you will use, examine your aggregates. See that they are clean and well graded, and determine what is the largest size present in any noticeable quantity in your large aggregate.

Second Step—The True Mix

You are now ready to determine your absolute or "true mix." This can be done very easily by using a diagram recently published by the Portland Cement Association, and republished with this article as "Figure 1." You will note that it is really four diagrams, one for each different type of slump. Select the section which corresponds to the slump you have decided to use, and select the point on it where the line marked with the largest size of your large aggregate crosses the line marked with the strength of the concrete you are planning to use. From this point a line drawn out to the left margin of the diagram will

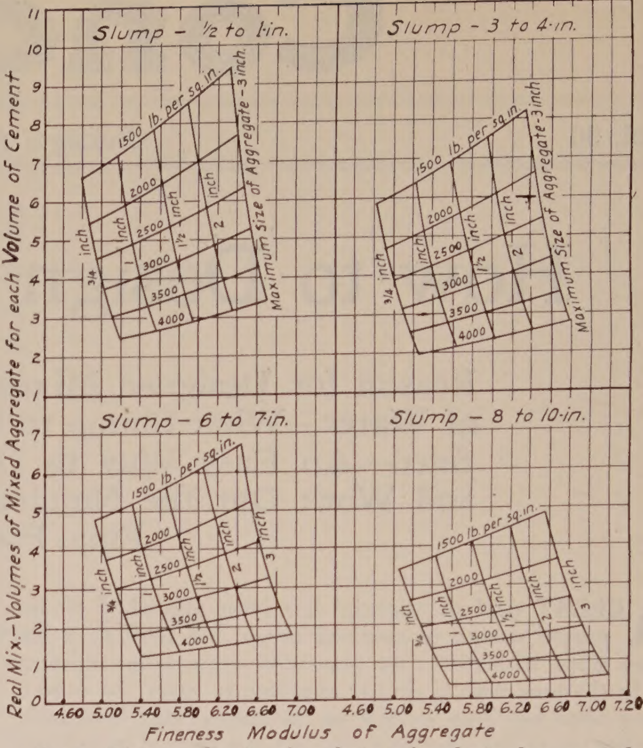


Fig. 1. Diagram showing the relation of real mix, fineness modulus, strength, and size of aggregate for various slumps. This is the chart used in the example cited in this article, and the chart to use whenever the amount of water used is kept near the minimum allowed in Table I

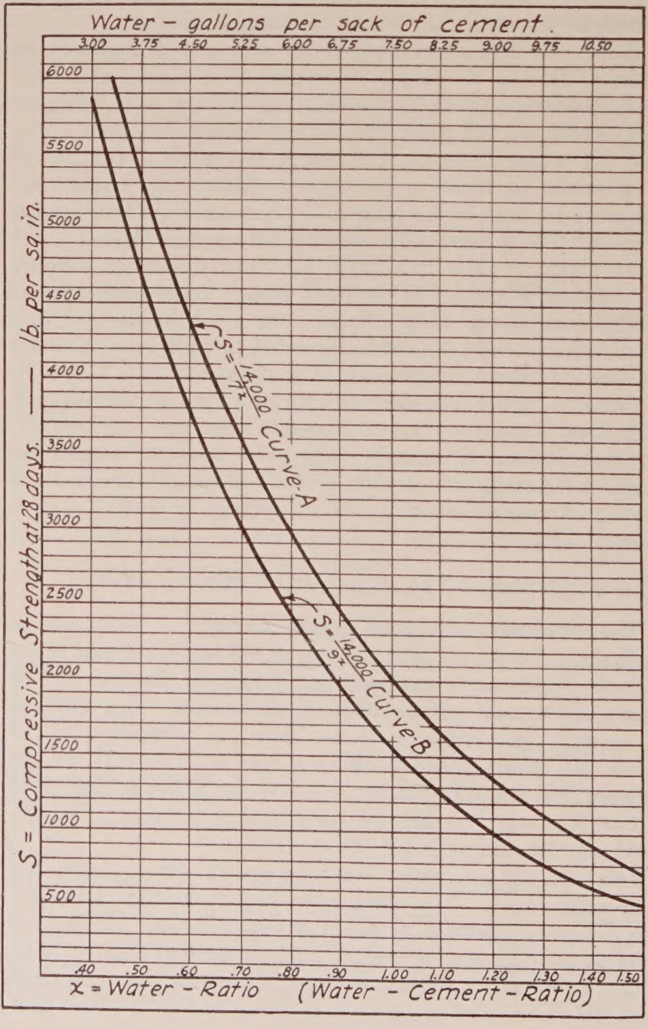


Fig. 2. This chart is to be used in place of Fig. 1, when the amount of water used is the maximum permitted by Table I

indicate your true mix, and one drawn straight down to the bottom of the diagram will give you your grading factor, or "fineness modulus."

For example, let us continue to suppose that you want to get a 3000-pound concrete, and that your largest sized aggregate is 1¾ inches. If you are going to use this concrete in erecting a reinforced concrete building you will probably want a slump of 6 or 7 inches, so we will use the lower left-hand quarter of the diagram. You will note that the 3000-pound line in the queer-shaped figure on the diagram is the second one from the bottom. But there is no line for 1¾ inches. There is one for 1½ inches, however, and another for 2 inches, so for 1¾ inches it is fair to take the point on the 3000-pound line halfway between where it crosses the 1½-inch line and the 2-inch line, and assume this point as the crossing of the 1¾-inch line.

The True Mix

If we draw a line out to the left from this point, it will hit the border of the diagram just below the figure 3, —say at 2.9. That is the aggregate figure of your true mix. The mix itself is written 1:2.9. A line drawn from the same point of intersection to the bottom of the diagram gives the figure of 6.20 as the fineness modulus. That completes your determination of the true mix. In the assumed instance of a 3000-pound concrete with a maximum aggregate size of 1¾-inch, it works out as 1:2.9, fineness modulus 6.20.

Third Step—The Nominal Mix

Since it is not possible to go out and buy a prepared aggregate with a fineness modulus of 6.20, it is necessary for us to translate our "true mix" into terms of so much sand and so much gravel of the kinds available. The first step in doing this is to find out the fineness modulus of the sand we are going to use, and of the gravel. Sometimes these figures can be obtained direct from the material dealer who supplies the aggregates, but very often they have to be worked out by the concretor himself. For this reason, every man who designs a mix should be prepared to work out the fineness modulus of the aggregates if that is necessary.

The ABC of Fineness Modulus

"Fineness modulus" is not nearly as complicated as it sounds. It means literally "a measure of fineness," and it is determined by adding up the quantities of various sizes of aggregates left on the various sieves of a standard set designed for making such measurements. The first thing is accordingly to get a set of these standard sieves.

To obtain the fineness modulus of sand you expect to use, take a thoroughly dry sample, weighing 6¼ pounds. Start with your finest sieve, and after shaking the sand well, and getting as much through the screen as will go, weigh the balance. (A common kitchen scale will do excellently for this.) Jot down the weight, *in ounces.* Repeat the process, using the next finest sieve, and again jot down *in ounces* the weight of sand left on the sieve. Continue this way until you reach a sieve with large enough openings so that no sand remains on it after shaking. Then add up your totals, put a decimal point two figures from the right, and you have the fineness modulus of your sand.

For example, suppose the amount which remains on the

finest sieve is	85 oz.
On the next	70 oz.
On the next	55 oz.
On the next	25 oz.
On the next	15 oz.
On the next	00 oz.
Fineness modulus is	2.50 oz.

With gravel (or crushed stone) the process is a little different, owing to the fact that a larger sample is needed. Take a 50-pound sample of the gravel (well dried) and proceed as with the sand, but mark down the amount left on each sieve in *pounds.* When you reach a sieve large enough to let all the gravel through, stop, and add up the weights of gravel left on all the finer sieves. Multiply this sum by 2, put a decimal point two figures from the right, and you have the fineness modulus of your gravel.

For example, suppose the amount of gravel which re-

mains on the finest sieve is	50 lbs.
On the next finest	50 "
On the next finest	50 "
On the next finest	50 "
On the next finest	50 "
On the next finest	50 "
On the next finest	35 "
On the next finest	15 "
On the next finest	5 "
On the next finest	0 "
Adding them	355
Multiply by 2	×2
Fineness modulus is	7.10

How the Nominal Mix Is Determined

After you have determined the fineness modulus of the sand and of the gravel you expect to use, you are ready to go ahead with the calculation of your *nominal mix.* The first step in the calculation is to discover what share of your aggregate is to be sand, and what share gravel. To do this you subtract the fineness modulus of your true mix from the fineness modulus of the gravel, and divide the result by the difference between the fineness modulus of your gravel and that of your sand. The result is the percentage of the total aggregates in your mix which should be sand.

Assuming that your sand has a fineness modulus of 2.50, and your gravel 7.10; and that the fineness modulus decided upon in calculating your true mix was 6.20, the problems work out as follows:

7.10 — 6.20 = .90
7.10 — 2.50 = 4.60
.90 ÷ 4.60 = .195 (the proportion of sand)

Or, to express it simply, 19½ per cent or about one-fifth of the total aggregates must be sand, and about four-fifths gravel.

The next step is to determine what these fractions mean in definite quantities, but to do this, account must be taken of the "shrinkage" which takes places in mixing two sizes of aggregates. The easiest way to determine the amount of this shrinkage is take a round can or measure of constant diameter and ten inches deep and measure out in this the amount of sand needed (in the problem we have been discussing 20 per cent or 2 inches in a 10-inch measure). When measured, empty the sand out into an empty receptacle of some sort. Take the measure of gravel needed (in this example 80 per cent) and put it aside also. In making these measurements use dry aggregates, and rod them into the measure to make sure they are the full amount. Then mix the two quantities, and put the mix back into the measure, rodding it as you do so. You will find that this will result in something less than a full measure, and this difference is the "shrinkage" of the aggregates. In the problem we are using as an example, the mixed aggregates would probably not come within about 1½ inches of filling the measure, leaving about 8½ inches that would be filled by aggregates which filled

10 inches of the measure when measured separately. In other words, the combined aggregates total about 85 per cent of the bulk of separately measured aggregates.

It is accordingly necessary to raise the figure of the true mix to get a figure which can be divided up into the proper quantities of separately measured sand and gravel to have them combine into a total volume that will equal the original true mix. This raising of the figure of the true mix is done by dividing it by the percentage which represents the bulk of combined aggregates as compared to the combined bulk of the separately measured aggregates,—in this particular problem, 85 per cent.

Taking the aggregate figure in the true mix determined in our first example, this works out as follows:

2.9 ÷ .85 = 3.4

giving a revised true mix, in terms of separately measured aggregates of 1:3.4.

This figure of 3.4 must now be divided in the proportions of sand and gravel previously worked out. In our problem this is one-fifth sand and four-fifths gravel. It results this way:

1/5 of 3.4 = .68 (sand)
4/5 of 3.4 = 2.72 (gravel)

Adding the figure for cement, our nominal mix now reads as follows:

1:.68:2.72

or, in round figures:

1:2/3:2¾

Fourth Step—The Field Mix

Owing to the fact that aggregates, particularly sand, bulk very considerably when damp, it is necessary to adjust the nominal mix to obtain a mix in terms of sand and gravel under job conditions. To do this, fill your 10-inch measuring can with loose damp sand, just as you are using it, and then dry it out thoroughly. Re-measure it when dry to see how much it has shrunk in volume. Assuming a can of damp sand becomes only 85 per cent of a full can when dry, you can obtain your field mix figure for sand, by dividing your nominal mix figure by this fraction of a full can of damp sand which the same sand well dried represents. It works out this way (using our former figures):

.68 ÷ .85 = .8 (field mix figure for sand)

Do the same thing in the case of your gravel. Find the proportionate volume dry of a full measure of damp gravel in job condition, and use this percentage to divide into the gravel figure from your nominal mix in order to get the field mix figure. Using our same example and assuming that the gravel will shrink about 5 per cent, this will work out as follows:

2.72 ÷ .95 = 2.86—field mix figure for gravel.

Combining these results we get a field mix figure for the assumed mix we have been using as an example, which is as follows:

1:.8:2.86

And in round figures, approximately 1:4/5:2 4/5.

This mix is not a particularly good one for any ordinary purpose. The example chosen is an unusual one, and was selected only to show how proper design principles will work out to the right solution, even under most improbable conditions. This mix meets the peculiar conditions for which it was designed, but it is hardly to be supposed that such conditions are apt to be met with by the average concretor. It would only be a practical mix under the very unusual requirements and choice of aggregates assumed in the example.

Final Step—Adjusting the Mix

When a mix has been worked out, and is actually put in use, minor adjustments are sometimes necessary, or at least desirable. It may be found that the mix is not as smooth and workable as wanted, and in that case an addition of a little extra sand will usually remedy the difficulty. When sand is added, however, the mix becomes dryer, and in order to overcome this, more water may be needed. But if it is used, be sure that extra cement is also added in proper proportion, so that the water-cement ratio is not affected. If any extensive corrections are made it is well to calculate the new fineness modulus of the total aggregates, and check the mix over again to make sure that in its revised form it is one that will give the desired strength.

General Precautions on Aggregates

Don't use a sand of which more than 5 oz. of a 6¼-pound sample will go through the finest of the fineness modulus sieves. Neither use sand nor gravel which is obviously dirty. Good, clean aggregates are essential to good concrete. Where washed aggregates are available, use them.

See that the sand contains no organic matter. If in doubt about this latter use the colorimetric test. It is performed as follows: Fill a 12-oz. druggists' bottle up to the 4½-oz. mark with the sand to be tested. Add enough of a 3 per cent solution of sodium hydroxide to reach the 7-oz. mark. Shake well, and let stand for 24 hours. If the solution turns dark, don't use the sand under any circumstances without a favorable report on it from some reputable commercial testing laboratory. A light yellow discoloration is not serious, but anything beyond that should cause the rejection of the sand.

Whatever combination of aggregates you decide to use, you should see to it that they are *well graded;* that is, that no one or two sizes monopolize the size range, but that there is instead a fair proportion of all sizes from the smallest to largest. Aggregates which grade regularly from small to large have less voids, and give a greater yield of concrete than those which are poorly graded. For this reason it is well never to overlook this point.

Note: The sieves and measuring can mentioned in this article are standardized equipment, and can be easily obtained. If you cannot get them from your local distributor we will be glad to put you in touch with manufacturers who make them.

Changes Made in Chicago Office of Association

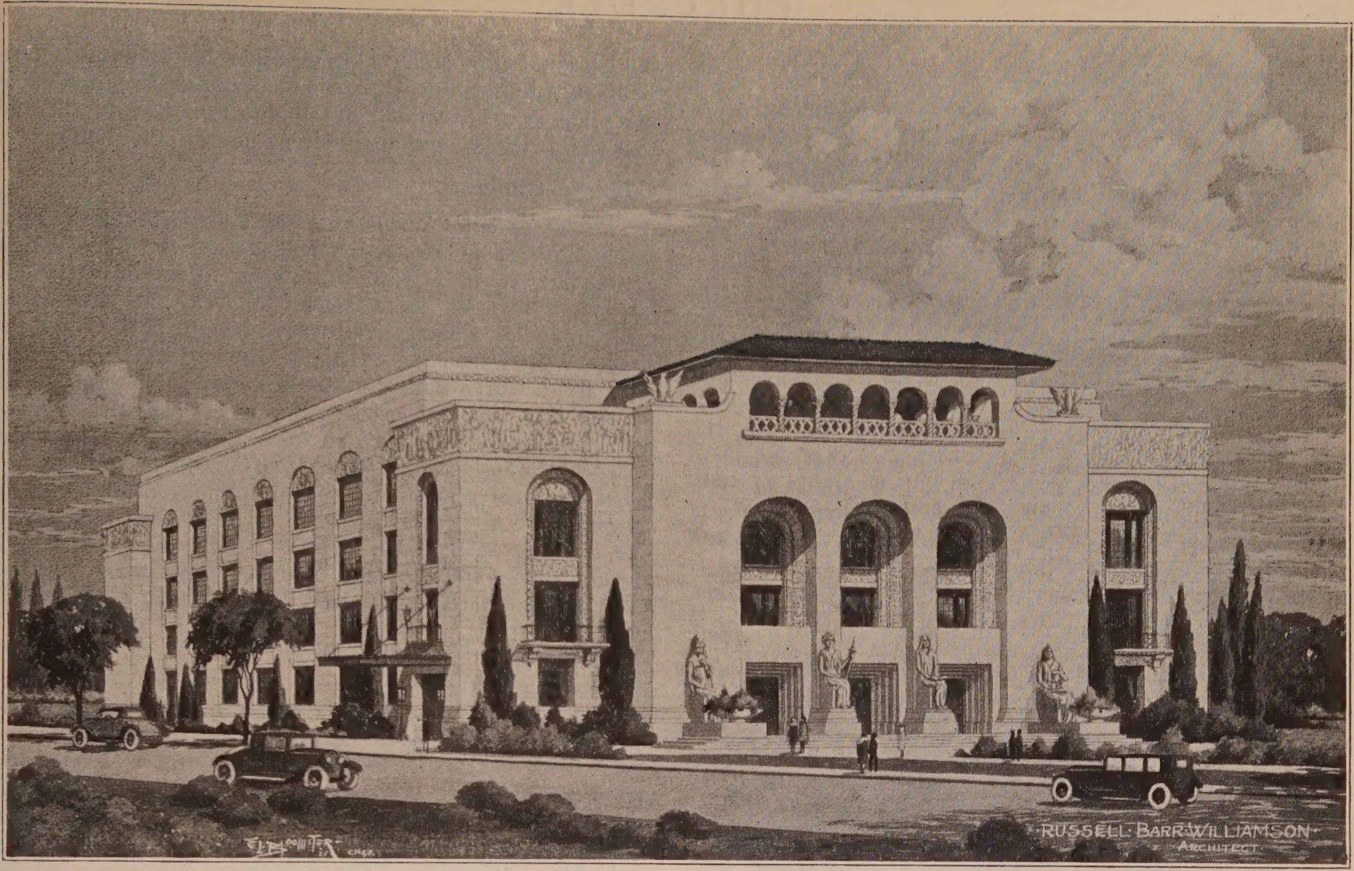
Mr. L. S. Trainor, formerly district engineer in charge of the Chicago office, has been appointed Manager of the Highways and Municipal Bureau.

Mr. O. A. Wakeman, who has been handling street promotion in Chicago, has been appointed district engineer in charge of the Chicago district office.

City Writes Concrete Sewer Pipe into Specifications

The Detroit City Council, by a vote of 5 to 3, on March 9th, changed the specifications for city sewer construction, admitting concrete pipe as acceptable to sanitary as well as storm water flow sewers. Heretofore only vitrified clay pipe has been used for sanitary sewers in Detroit.

One of the purposes of changing the specifications, according to those who voted to do so, was to prevent those interested in clay pipe products from monopolizing the market and raising prices.



The new Eagles Lodge in Milwaukee. The statues, frieze and all external ornamentation is of concrete trim stone. Russell Barr Williamson, architect

The Basis of Tomorrow's Design*

An Architect Discusses the Possibilities of Concrete As a New Medium of Design—Structural and Design Features Can Be Worked Out in the Same Material

By RUSSELL BARR WILLIAMSON

GRANITE, marble, limestone—these are the bases of design and of decoration to the average architect. He realizes the wealth of natural beauty in these stones, he knows the important part they have played in the history of his profession. He has perhaps stood before some century-old structures which stand as immortal edifices to their designer. He has observed the use of cut stone in these renowned buildings; he has seen how its use has given beauty a permanent form. To him, design suggests one of these stones.

Now, while he is particularly interested in design, let's bring up the subject of concrete. Yes, concrete is a wonderful material. Unsurpassed for construction purposes. Has made fireproof buildings possible. When a building's put up with concrete, you know its there to stay.

A New Medium for Design

But, how important is concrete as a medium for design? Its structural value is generally recognized. It is known among engineers as a fireproof, strong, permanent building material. Now, just how valuable is it to the designer, the man who is interested in the appearance of the building, as well as in its structural features?

Oh, it's been used now and then, but—. The "but" carries with it a wealth of meaning. It infers that such masterpieces as the Parthenon, St. Paul's Cathedral, the Coliseum at Rome were wrought in cut stone, that every great school of monumental architecture has used this material, and that the old masters knew what they were about. Concrete may be a fine material, but it is made primarily for structural purposes.

True enough. But, go a step further. Give the old masterpiece a little more consideration. If their design was carried out in cut stone, so also were their structures. In other words, construction and design were both conceived in the same material. There is in these great works a definite relation between structure and ornamentation, that is clearly indicated in the fact that both engineer and designer (if the two can be considered separately) worked with the same material.

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*Paper delivered at the Wisconsin Concrete Products Association Meeting at Milwaukee.

Structure and Design a Unit

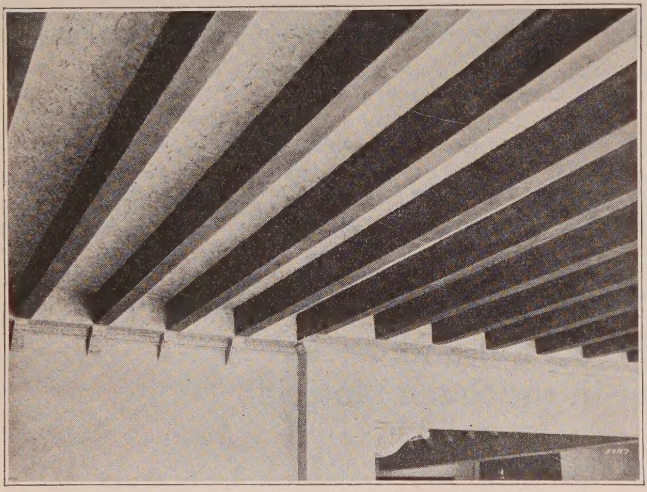
This leads to an important truth—one might call it an axiom—regarding architecture. In all real art, structure and design form an inseparable unity. The close relationship between them makes it impossible successfully to divorce one from the other. And the most effective ornamentation must be wrought in the material used for construction.

Perhaps the reader may think by this time that he is in the middle of a rambling, disconnected discourse on the philosophy of architecture, which bears no direct relation to his work. Ornamentation, fireproof construction, the Parthenon have already passed in review. What next?

If the metaphor will be pardoned, let us have the parade stop momentarily at the statement that ornamentation and construction must both employ the same material. If this was true when Sir Christopher Wren was preparing specifications for St. Paul's, it is true today. In architecture, as in all other arts, truths are eternal. Their applications, however, vary with the passing of time.

A New Structural Era

The present day represents a distinct structural era. We live in an age of concrete construction, of skyscrapers, of monumental office buildings, of gigantic stadiums. The history of building has entered into a new period, and the designer must recognize the change.



Concrete beams, moulded in metal forms, were part of the interior decorative scheme. The joists were stained a mahogany color, while the arches between the joists were coated with a heavy Craftex paint and stippled to give a rough effect

Translated into practical terms, this means that for the most part, the buildings of the future will be constructed and designed in concrete. The unity between structure and ornamentation will be effected through the use of this material, which will serve both the engineer and the designer.

The architect who thinks of concrete from purely a structural angle will change his viewpoint, when he realizes the possibilities it offers for artistic expression. Consider for a moment those qualities which make it valuable to the designer, irrespective of its worth as a means of construction.

When properly mixed, concrete is a close-knit material of even color and texture. It is, before hardening, highly plastic, and can be made to carry out any design for which forms can be made. It furthermore permits of coloring before mixing.

With such a material the designer has an unlimited range of opportunities before him. He is not limited by the skill of the stone cutter, when he evolves a particularly complex piece of ornamentation. He knows that his plans can be carried out to the minutest detail, and that they will become an inherent part of the whole.

Color in Concrete

The use of color opens an almost virgin field for him. When he uses cut stone, he must accept the hues nature gives him. As she is a great designer, he is not often seriously handicapped, nevertheless, he is always obliged to make his color schemes conform to her dictates. If he encounters an especially brilliant color idea, he must, as long as he works with cut stone, ascertain if nature will furnish him with the necessary tints and shades. If she will, well and good. If she will not, however, he must revise his plans to make them conform to her whims.

Let him evolve any color scheme he may desire, and its conception is a virtual certainty, if he works in concrete. The hues he selects are mixed into the concrete in its plastic state, and become a component part of the materials, and are unimpaired by the passing time.

No Size Limitations

A further advantage assured through the use of concrete in design is found in large scale work. There are certain definite limitations on size in cut stone ornamentation. Most of these can be eliminated in concrete. A recent instance of concrete proving the only means of artistic realization is the construction of Lorado Taft's theme, "The Fountain of Time." In speaking of this work, Mr. Taft said: "The monument had grown to be so long, so high, so complicated that I couldn't even get a bid on the carving of it." In discussing the completed monument, he remarked, "There is not a stone that America produces—not a material, even Tennessee marble—that I would prefer to the color and effect we have produced in 'The Fountain of Time.' "

The architect of the future will meet many problems similar to that which confronted Lorado Taft. The gigantic proportions now employed in construction will demand gigantic ornamentation, which in turn will require for successful realization the use of concrete.

One can see this movement toward larger buildings with little difficulty. Our movie houses are massive temples of entertainment, our football fields are designed to house not merely a few students and some loyal alumni, but the sport fans of several states. Our exhibition buildings, our office blocks, our railroad stations have dwarfed the structures of a few years past into virtual insignificance.

These changes in structure must be reflected in design. The design employed must harmonize with the construction material. Concrete, used in ornamentation, will meet the needs of the designer who must build art into our present-day structures.

In the recent instances in which architects have used concrete for decorative purposes, the results have been satisfactory. Columns and pillars, arches and doorways, friezes, balconies, statuary, frescoes, railings—these are but a few of the many parts of a modern building, where concrete has been used for artistic uses.

You will find this substance used in good taste and with singular effect on hotels, office buildings, churches, public edifices, schools and skyscrapers. It carries the minute details of decorative sculpture; it lends distinction to a massive doorway; it carries an ornamental motif on the wall of a church; it beautifies the sides of a skyscraper. Whenever the designer uses it to carry out his ornamentations, he meets with results that not only are gratifying, but which also give his work that structural unity, which distinguishes edifices of high merit.

Reinforced Concrete Panel Walls in Structural Frames

A Discussion of the Methods in Use for Building Reinforced Concrete Panel Walls—Should They Be Monolithic with the Frame or Separated—Some Building Code Requirements on Concrete Panel Walls

FROM a study of engineering reports covering violent wind-storms and severe earthquakes of the last few years it is not difficult to draw the conclusion that two structural types of buildings stand out as pre-eminently successful in resisting these natural forces. The two types in question are the reinforced concrete structural frame and the concrete-encased steel frame, the exterior panel walls and the floor construction being of reinforced concrete in each instance.

Much difference of opinion exists regarding the proper method to be followed in the construction of the panel walls. These panel walls, sometimes called filler walls, fill in the exterior wall space not occupied by columns and girders. They are supported at each story by wall girders, and ordinarily they carry nothing but their own weight.

Two Types of Concrete Panel Walls

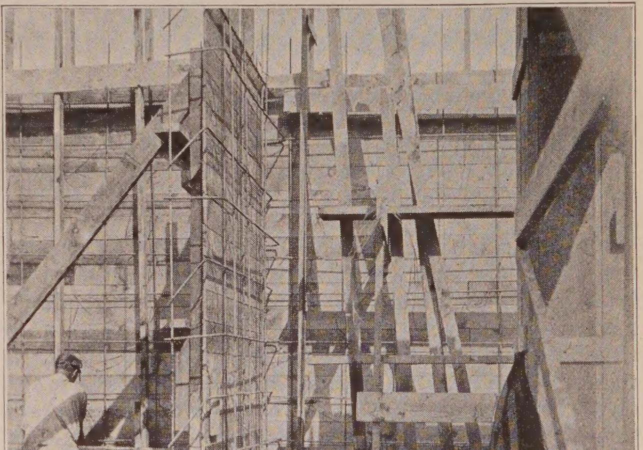
From the fact that these panel walls occupy the space between columns and girders it is certain that they add much to the lateral strength of the structural frame. Opinion is at variance, however, as to whether the walls should be concreted along with the structural frame and made an integral part of the frame, or whether they should be concreted separately. When concreted separately, the common practice is to leave keyed joints between the panel wall and the structural members. The keys in the columns and girders which hold the panel walls in place are provided at the time the structural frame is concreted.

Advocates of the practice of concreting panel walls separately say that unless joints between wall and frame are provided in advance, cracks will surely develop later. Those who favor the practice of concreting panel walls integrally with the structural frame say that this must be done in order to obtain the full benefit of the additional rigidity obtainable from the walls. Sufficient steel reinforcement properly placed will prevent cracks, in their opinion. This method, they say, produces a structure in which frame, walls and floors are a continuous monolith, capable of resisting the most violent forces of nature within modern experience.

An outstanding argument in favor of concreting panel walls integrally with the structural frame may be found in the performance of the Maranouchi Building, in Tokyo, during the Japanese earthquake of 1923. This building had been provided with several reinforced concrete cross-walls to furnish additional stiffening against possible earthquake shock. The cross-walls were in the nature of series of panel walls, concreted separately, so that joints occurred between the wall panels and the columns and floor girders. The cross-walls were quite badly shattered.

What happened in this instance was that the joints permitted a very slight freedom of movement between the wall panels and the structural frame, a movement that was sufficient to crush the wall panels when the frame was distorted by the vibration induced by the earthquake. It is altogether probable that if the cross-walls had been integral with the frame this shattering could not have occurred.

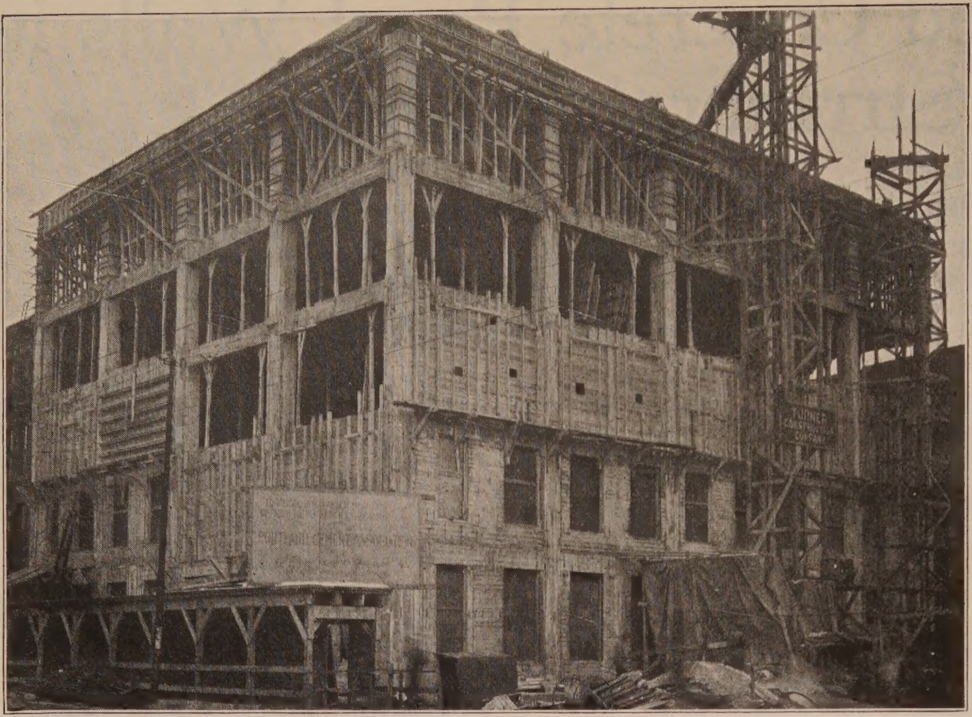
Eastern and Western Methods



When the panel walls are connected as an integral part of the structural frame, the structural concrete work can be completed in a single operation

As a general thing it may be said that in the East the prevailing practice is to concrete the panel walls separately, after the structural frame has hardened, and to leave keyed joints between wall and frame. On the Pacific Coast the more common practice is to concrete the panel walls along with the structural frame as an integral part of the frame, thereby producing a monolithic structure of great strength and rigidity.

From the standpoint of cost the panel wall that is concreted as an integral part of the structural frame is more economical to construct than the separate panel wall. When the wall is concreted integrally with the frame the structural concrete work is completed in one operation.



Concreting panel walls separately has a disadvantage in the matter of cost, for the reason that a second concreting operation is necessary several weeks after the concrete in the main structural frame had been placed

When the wall is concreted separately that part of the work must be done in a second operation following several weeks after the placing of concrete in the structural frame.

Practice on the Pacific Coast, with respect to construction details of panel walls that are integral with the structural frame, is of interest because of the success attained there with that type of wall. In Seattle, for instance, the city building code requires concrete panel walls to be reinforced with not less than one-tenth of one per cent of steel in each direction, both vertically and horizontally. Considering that the code permits a minimum thickness of 4 inches in such walls, the amount of reinforcement required is surprisingly small. But the proof of the adequacy of this requirement may be found in the fact that no trouble has developed from this source in Seattle.

Anchoring Panel Walls

It is the common practice in Seattle to give particular attention to the anchorage of panel walls to the structural frame. After a floor is concreted the wall forms and interior column forms are put up and the steel reinforcement is secured in place. The form work for the next floor is built at the same time. The vertical reinforcing bars in the wall extend from the top of the supporting floor to a level of about 20 inches above the top of the next floor. The horizontal wall steel is placed around or through the reinforcing steel of the wall columns. Consequently both the vertical and the horizontal reinforcing bars have sufficient lap or anchorage to develop their full strength and to make the wall panel integral with the structural frame. In the concreting operation the walls and columns are concreted to the bottom of the lowest intersecting beams, after which one day is allowed to elapse before the floor system above is placed. This cycle of operation is, of course, repeated at each story.

An interesting structural detail that provides positive anchorage between reinforced concrete panel walls and frames of concrete-encased structural steel may be seen in a method often utilized in San Francisco. Holes are drilled into the upper flanges of the supporting wall girders, through which the vertical reinforcing bars of the panel walls are passed. This detail provides continuity between the panel wall and the concrete-encased steel girder. Even if such walls were broken across the double-diagonals so characteristic of earthquake damage, they would not be thrown off the wall girder if anchored in the manner just described.

Reference has already been made to certain minimum requirements of the building code of Seattle, with respect to reinforced concrete panel walls. The minimum thickness is 4 inches and the minimum reinforcement is one-tenth of one per cent placed horizontally and vertically.

The building code of Portland sets the minimum thickness at 6 inches and the minimum reinforcement at one-fourth of one per cent in each direction, both horizontally and vertically.

Section 116 of the San Francisco building code calls for a minimum wall thickness of 6 inches, with a minimum of about one-fifth of one per cent of horizontal reinforcement and one-seventh of one per cent vertical.

The Los Angeles building code requires reinforced concrete panel walls to have a thickness of not less than 8 inches. Vertical and horizontal steel must be placed near each face of the wall, but the total quantity of steel required as a minimum is very small, amounting to about six one-hundredths of one per cent in each direction.

It is evident that the use of reinforced concrete panel walls in buildings of the structural frame type is on the increase, and that it is a subject that merits scientific study. First, we have the difference of opinion over the relative advantages of panel walls concreted integrally with the frame as opposed to separate panel walls provided with joints between wall and frame. Study and investigation might determine which of the two constitutes the better practice. Second, the great variation in minimum reinforcement permitted by the building codes of four Pacific Coast cities is an indication of a wide difference of opinion concerning the amount of reinforcement needed. It is noteworthy that so much variation in building code requirements should exist in the region where the reinforced concrete panel wall is most commonly employed.

Tests of Colors for Portland Cement Mortars

By RAYMOND WILSON
Associate Chemist, Portland Cement Association

THE increasing uses of concrete in architecture are bringing the subject of colors in concrete into the foreground. Here are presented the conclusions from a series of tests now under way at the Portland Cement Association Laboratories. They were presented at the recent A. C. I. meeting at Chicago as part of a progress report on investigations of the effect of commercial pigments on the color, permanence of color and compressive strength of portland cement mortar.

EXPOSURE tests have been made on about 2400 mortar discs colored with integral admixtures of 264 commercial pigments. Quantitative measurements of the color of the discs were made by the use of the Munsell Color System and from the changes in color due to exposure to weather some relations between chemical composition of the pigments and the color permanence of the mortars have been determined. Data on the effect of weather on the color during 6 mo. exposure are considered in this paper.

All the pigments were subjected to exposure tests in 1-3 white cement mortars with 5% and 10% admixtures (by weight of cement) of the buffs and yellows, 1% and 2% of the carbon blacks and 3% and 6% of the other pigments. More intensive tests were made on 17 pigments of representative chemical composition; these pigments were used in studies of their effect on strength of mortar at various ages from 7 days to 5 years, and on color, color permanence and 28 day strength, as influenced by hydrated lime admixtures and curing conditions. Six pigments were selected as representative of the predominant chemical composition in the various hues for tests of the effects of mix and consistency of the mortar and quantity of pigment.

In the rather small quantities used in the greater portion of these tests most of the representative pigments which were of satisfactory permanence did not cause great variations in strength. Pigments containing calcium sulfate had the same general effect as admixtures of gypsum. Admixtures of from 1% to 10% of carbon black reduced the strength under all conditions of test though there were variations in the actual reductions obtained in groups of tests made at different times and in which there were some duplication.

Admixtures of 10% and 20% of ochre, red iron oxide, black iron oxide and chromium oxide resulted in somewhat increased 28-day strengths under the conditions used in one group of tests. Larger quanties of ochre, red iron oxide and chromium oxide caused reductions while only slight changes in strength were caused by 35% or 50% of black iron oxide.

Conclusions

The most important conclusions which may be drawn at present are:

1. Most of the pigments used in these tests, and which are probably representative of those now on the market, are of a satisfactory degree of permanence, so far as may be judged by 6 mo. exposure tests in 1-3 portland cement mortars.

2. The following types of pigments were suitable from the standpoint of permanence after 6 mo. exposure:

Buff, yellow, red: iron oxide pigments.
Green: chromium oxide.
Blue: ultramarine blue.
Brown: iron oxide, or iron and manganese oxide pigments.
Black: iron oxide, manganese dioxide, carbon black, bone ash and the so-called mineral blacks (coal, coke, and certain unidentified carbonaceous materials high in mineral matter.)

3. Cadmium lithopone, zinc chromate and organic colors are not suitable for general use in portland cement mortar.

4. Among the pigments classed as of satisfactory permanence after 6 mo. exposure, no differences in degree of color permanence could be observed.

5. In cases where abrasion may result in exposure of the aggregate by removal of the coating of colored cement paste care should be taken to use aggregates of a neutral color or of a color which will harmonize with that of the pigment.

6. The ratio of pigment to cement is the most important factor affecting the color of mortar produced by a given pigment.

The effect of a given pigment on the color of a mortar as expressed in terms of the Munsell system is proportional to the logarithm of the quantity of the pigment, the *chroma* being directly, and the *value* inversely proportional.

7. The kind of cement and the mix and consistency of the mortar are factors of secondary importance affecting the color. Curing conditions and admixtures of hydrated lime make practically no difference in the color, other conditions being the same.

8. Under some conditions quantities of certain mineral pigments in excess of the 10% generally recommended as a limit may be used without seriously impairing the strength. These tests are not broad enough in scope to serve as the basis of a general recommendation regarding the quantity of various pigments which may be safely added without serious reductions in strength.

9. In mortars containing the quantities of pigments usually used, the effects of water-cement ratio, mix, consistency and curing condition on the compressive strength are about the same as on mortar without pigment.

10. Iron oxide black is preferable to carbon black since equally dark colored mortar can be produced with the iron black with less reduction in the strength of the mortar.

A Proposed Code of Ethics for the Concrete Products Association

By AUSTIN CRABBS

TO elevate the standards of the industry and to help gain the confidence of the general public to which our industry is entitled, this Code of Ethics is offered by the Concrete Products Association as a guide to correct practice. May it encourage and foster high ethical standards in all our business relations.

Section One—Relation of Employer and Employee

1. The employer shall appreciate his obligation to his employees and shall realize that their interests are mutual.

2. The employer shall strive to pay as high a wage as paid by others in similar industries so that the employee may have an opportunity to save and improve his standard of living.

3. The working conditions shall be improved as rapidly as possible, so that the employees may have light and air and healthful surroundings. Labor saving devices shall be installed as rapidly as possible to help take the drudgery of an essentially heavy occupation from the shoulders of the employees.

4. The employer shall strive to furnish continuous employment for faithful workers and shall properly reward industrious, loyal, and efficient effort.

Section Two—Relations with Those from Whom Purchases Are Made

1. Courtesy shall be extended to all salesmen inquiring for business, but the right is reserved to refuse an interview to those wishing to present some proposition of no interest to the purchaser. It is not courteous to keep a salesman needlessly waiting as his time, too, is valuable.

2. No dishonest statements shall be made or unfair advantage taken to secure lower prices, nor shall prices received from one firm be disclosed to a competitor.

3. The terms of payment shall be neutrally agreed upon at the time the purchase is made and then shall be adhered to; no discount for cash shall be taken after the time fixed has passed.

4. No commission, gratituity, allowance, or indirect profit of any kind shall be accepted in connection with the purchase.

Section Three—Relations with Our Fellow Craftsmen

1. We shall realize that our interests are mutual and shall strive to cooperate and through an exchange of ideas, improve and expand the whole industry.

2. We shall not make false or disparaging statements of a competitor's business, of his product, or of his prices, nor shall we appropriate any of his trade names, slogans, or advertising matter.

3. We shall not offer employment to our competitor's employees unless, without solicitation on our part, they ask for employment.

4. We shall not solicit the cancellation of an order placed with a competitor nor shall we accept an order knowing it to be previously placed.

5. We shall not obtain prices from a competitor through bogus requests by a third party.

Section Four—Relations with Other Lines of Business Interlocking with Ours

1. We shall cooperate at all times with other associated lines of business and with other organizations who are working along lines similar to ours, with a view to giving and obtaining assistance of mutual benefit.

Section Five—Relations with the Public

1. We shall consider our business a worthy one and justified only to the extent to which we serve the community and the territory in which we operate.

2. We shall endeavor to keep informed as to new developments in the industry in order to keep our own business up to date and to enable us to give the public, as soon as possible, the benefit of improved methods or machinery.

3. We shall take an active interest in the welfare of our community and support all worthy civic movements to the fullest possible extent.

Section Six—Relations with Our Customers

1. Our salesmen shall be able to offer valuable suggestions to the purchaser, so that he may buy wisely and build well. We shall try to train our salesmen to be more than mere order takers.

2. Every customer shall be given our best service and consideration regardless of the amount of his purchases.

3. We shall avoid misrepresentation and false statements at all times, in our oral statements, in our letters, or in our advertisements.

Section Seven—Making and Executing of Contracts

1. All contracts shall be made as plain and straight forward as possible and their chief aim shall be the mutual profit or benefit of all parties.

2. Written and oral contracts shall be considered of equal validity.

3. The honor of the industry shall be maintained through the faithful performance of all contracts, either written or oral, in spirit as well as in letter.

Section Eight—Wrong Practices

1. We shall not give out-of-the-ordinary service, as all transactions should be mutually profitable.

2. We shall not participate in any movement contrary to law or public welfare.

Section Nine—Conclusion

1. The adoption of this code of ethics by the Concrete Products Association places an obligation on its members to the sincere and faithful performance of these rules of conduct and each individual member shall be pledged to conduct his individual business so as to merit the confidence and respect of the public and reflect honor on the entire industry.

Standard Ottawa Sand

Where It Comes From—What It Is—How It Is Produced

Since 1909 American specifications have required the use of "Standard Ottawa Sand" in measuring the strength of both cements and sands. To many engineers this expression has become commonplace through long familiarity and the requirement in the specifications directs little thought to the sand itself, how it came to be used, where it can be obtained or how it is prepared for use as a product having the exact qualities required. In the following story these things are explained. After reading it, the term "Standard Ottawa Sand" will mean more to the engineer and contractor than a mere standard of measurement.—The Editors.

STANDARD Ottawa is produced from St. Peter sandstone, which belongs to the Cambrian period and was formed many millions of years ago when what is now the Middle West was the bed of a vast inland sea. St. Peter sandstone outcrops in Illinois, Wisconsin and northern Iowa, where river valleys have worn away the overlying glacial drift. The sand grains of which it is composed are almost pure silica or quartz, naturally white in color but often stained red, blue, orange, yellow, indigo and all the intermediate colors by percolating mineral waters.

Near Ottawa, Illinois, the river has left the sandstone with only a thin covering of sandy loam. The Ottawa Silica Company, which prepares "Standard Ottawa," removes this dirt with a steam shovel and sweeps the surface clean of all dirt, even to the extent of digging into each crevice with a small paddle, leaving the clean sandstone exposed as the first step from ledge to sack.

The layer of sandstone is about 50 feet thick and has disintegrated to such an extent that it can often be shoveled up like sand. When it is exposed to the air, however, it hardens so that the old faces of the sand pit have every appearance of a rock quarry. These exposed faces are reduced to sand piles by light charges of dynamite.

Standard Ottawa sand, used as the measuring stick for quality, comes from this ledge of almost pure silica sand near Ottawa, Ill. Water under 100 pound pressure breaks down the shattered ledge of rock and piles the sand near the pumps that convey it to the plant

After the rock is shot down, the sand is washed from the shattered ledges by a stream of water as in hydraulic mining. One man holds the nozzle of the hose and directs the water against the face of the blasted ledge from which the sand crumbles in an avalanche to the foot of the ledge. The pumps pick it up and discharge it through pipes to a large relay pump which, in turn, collects this fluid mixture from the various pumps and delivers it to the foot of an inclined cleat elevator. By this means the sand and water are lifted to the top of the washing bins. Here the sand is discharged into a rotary screen which removes all the pellets before feeding the bins.

A long inclined elevator carries the sand from the quarry to the mill

The sand, having passed through these operations, has been severely agitated and the grains have scoured and rubbed against one another until any foreign matter, mineral or vegetable discoloring which may have surrounded these pure silica grains, has become loosened and is now in the water in a powdered form. But there are still other washings in store for it. It is forced through several washing bins, sprays, etc., and it is not until after the fifth and final washing that it is considered clean. All this care is taken to remove a small part of 1 per cent of foreign material.

The sand is then placed in draining bins. After 24 hours in the draining bins it contains about 3 to 4 per cent of moisture. Next come the V-shaped drying bins, through which the sand runs past hot steam coils which remove every particle of moisture.

Screening

The fine, dry, perfectly white sand, looking much like sugar, runs from a line of very small holes in the bottom of the drying bins onto a belt, is carried to a bucket elevator and lifted to the screens that separate the different sized grains. It is here that the sand is first screened to be used in producing "Standard Ottawa." Less than 1 per cent of the sand produced by the Ottawa Silica Company is sold as Standard. The rest is used in making glass, for an abrasive in sawing stones, as molding sand and as fine aggregate in white stucco as well as in sand blast machines for cleaning buildings or polishing castings. Ground to the fineness of flour in a tube mill, it is also used in the manufacture of pottery.

The sand is washed five times to assure absolute cleanliness and is then allowed to dry

The small proportion of the total sand that can be sold as Standard is that which will pass a sieve having 20 meshes per lineal inch. Each mesh must have an opening of 0.0335 inch, must have between 19.5 and 20.5 wires per whole inch of the warp wires and between 19 and 21 wires per inch of the shoot wires. The diameter of the wires should be 0.0165 inch and the average as measured shall not vary outside the limits 0.0160 to 0.0170. The sand must be retained on a sieve having 30 meshes per linear inch; each mesh must have an opening of 0.0223 inch, must have between 29.5 and 30.5 wires per whole inch of the warp wires and between 28.5 and 31.5 wires per whole inch of the shoot wires. The diameter of the wire should be 0.0110 inch and the average as measured shall not vary outside the limits 0.0105 to 0.0115 inch. These sieves must be woven (not twilled) from brass or bronze and mounted on the frames without distortion.

Less than 1 per cent of the sand produced can be used as Standard Ottawa

Insuring Uniformity

The sand, having been roughly screened in the large mill, runs down a pipe to a smaller standard sand house, where it is again screened, this time very carefully. The sieves for this final sizing are about two feet square and are made of accurately woven standard sieve wires. They are agitated by electric motors. The sand is first placed upon the coarser 20-mesh sieves. All of it that passes is placed in the 30-mesh sieves where it is agitated until a sample, shaken for three minutes on a standard laboratory sieve, shows that the sand passes the rigid requirement that 99 per cent shall be within the sizes named. It is then weighed into burlap sacks holding 100 pounds each. Samples are taken from the sacks and tested on laboratory sieves by the plant superintendent himself, as a check on all previous steps.

It is packed in 100-pound bags for shipment to the nation's laboratories

A typical chemical analysis of the sand shows it to be 99.89 per cent pure silica, and 0.11 per cent of iron, alumina, lime and magnesia combined.

It is a long step from the quarry to the clean, accurately sized Standard Ottawa on the way to laboratories everywhere. The great care used in the preparation of Standard Ottawa assures cement users of a standard of measurement that never varies. And so it has come to be used almost universally in specifications governing the quality of cement and sand.

EDITORIALS

The Water-Ratio Specification

AT the recent convention of the American Railway Engineering Association, that body took a definite step forward in concrete construction practice by adopting as standard a new set of concrete proportioning specifications based entirely on the water-cement ratio law. The new specification for plain and reinforced concrete was prepared and presented for adoption by the Association's Masonry Committee. Because of its adoption by the Association, this specification will become the recommended practice for all the railroads in the United States and Canada.

The adoption of this specification marks the end of the old 1:2:4 method of proportioning by arbitrary mixes in the railway field, and substitutes for it the more economical and scientifically sound method of fixing the amount of water to be used with each sack of cement, leaving the proportions of the fine and coarse aggregate largely to the discretion of the individual engineer.

The railroad engineers who made this change acted on experience. They have long been in the vanguard of better concrete construction and the use of the water-cement ratio and scientifically designed concrete is not new in the railway engineering field.

The adoption of this specification by the A.R.E.A. is especially noteworthy because it is probably the first instance where a national or international engineering organization has placed its stamp of approval on a strictly water-cement ratio specification. Such action by an organization with an enviable reputation for its painstaking work in the preparation of specifications carries great weight.

Construction Service

THE contractor, along with the concrete products manufacturer, is awakening to the need of merchandising his wares. He is beginning to realize that he, too, has a sales problem. In fact, at the recent meeting of the Associated General Contractors, a discussion of this subject was considered the keynote of the convention.

Contracting is no longer gambling. Today the contractor knows his costs and when he undertakes to put up a building, he renders his client a real construction service that calls for special skill and a high degree of integrity. Yet, under the forms of contract in force today on the greatest number of jobs, the contractor is forced to sell ***price*** rather than ***service.*** All contractors — responsible or irresponsible—are forced to compete on equal terms only on the basis of ***price.***

There are indications that this method is passing. Already contractors of established reputation are securing jobs on the basis of ability and responsibility alone. In some instances, only contractors of established standing are invited to bid. In a few cases jobs are awarded simply on a fixed fee basis or on a cost plus basis. All of these are indications that the builder and owner knows and appreciates that there is such a thing as construction service that cannot be bought through price competition.

Constant educational work along these lines will break the absolute power of the low bid. It will apply to the contracting business those principles that have built up other industries and it will teach builders that there is, in the building industry, a market for a better product, even at a higher price.

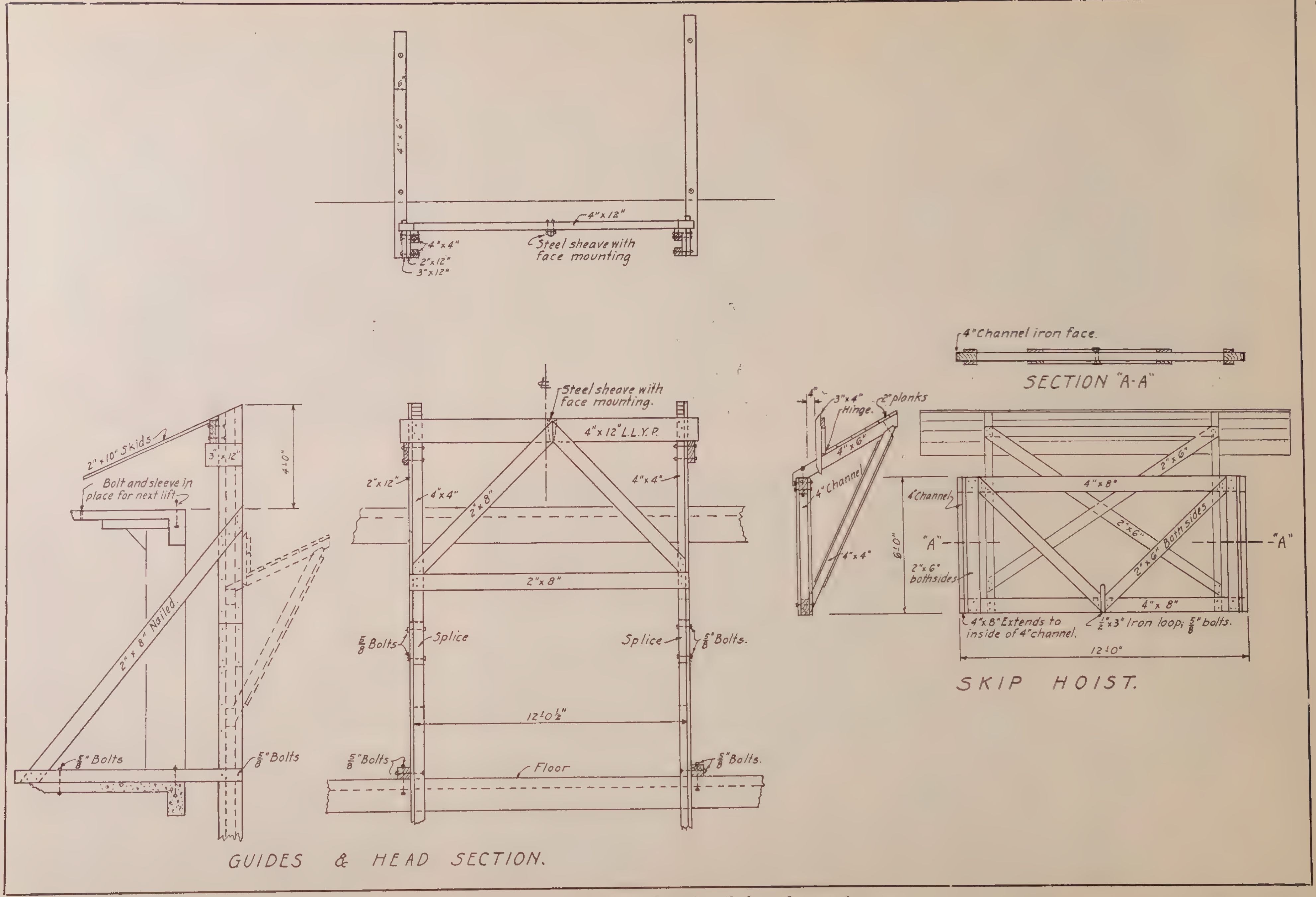
Material vs. Material

EVIDENCES that competition is now a matter more of material against material rather than individual manufacturer against individual manufacturer are at hand wherever you turn. Almost every industry is now organized into some form of association for the purpose of competing with other industries. Much merchandising effort and much advertising is now placed on a basis that embraces an entire industry, rather than merely an individual brand.

In the concrete industry this development is very well advanced. There is the Portland Cement Association, the many Concrete Products Associations, the Concrete Pipe Association, and many others. All of them are organized to consider only the group interests of the members, subordinating the individual interests to the common good. They have found by experience that they, individually, prosper as the industry prospers. The local concrete products associations are organized to put over the advantages of the concrete masonry unit in their community. If the builders are sold on concrete block in general, they have created a larger market and each individual member derives the benefits from increased sales.

For some time the concrete industry has had the advantage over other industries in this respect. But the competing materials interests have seen the benefits that follow movements of this kind and are now organizing along similar lines. More than ever competition will be placed on an inter-commodity basis.

There is an indication of danger in the concrete field. Instead of promoting merely the concrete masonry unit, for instance, there are complications arising over whether that unit shall be a concrete block, a concrete tile or a cinder concrete block. While these subdivisions of the concrete units group are quarrelling, the clay tile man may walk in and get the job.



Working drawings of the material hoist described on the opposite page

A 1927 Model Material Hoist

Improvements Added to Hoist Developed After Study of Older Types and Use of Many Designs on a Multitude of Jobs—An Efficient, Economical Hoist Easy to Erect Ahead of Forms

THE contractors of the Middle West have been developing a material hoist that has proven very useful, particularly on high reinforced concrete buildings. The use of such a hoist is spreading to other parts of the country, as rapidly as other contractors see its advantages. This form of hoist is utilized for hoisting form lumber and reinforcing steel, and even such specialties as piping, conduits, and so on, automatically unloading the materials on the floor on which they are to be used. Working drawings for its construction are shown on the opposite page.

During the course of the evolution of the material hoist, the users have found and remedied various defects in the original designs. The first versions of the device sometimes proved expensive to erect, the platform frequently skewed and stuck in the guides, splices in the guides proved unstable, and other troubles were revealed. Many of them proved to be power eaters and that drawback had to be overcome.

The design presented here was given to us by C. H. Schwertner, a construction superintendent at the time in charge of the erection of the Paidar Building in Chicago. Some of the developments shown in the drawing were tried out on that job, and other details were suggested as a result of that latest experience.

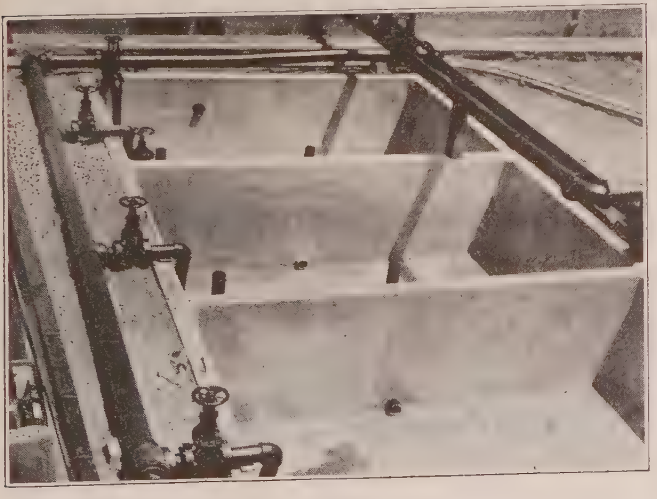
Mr. Schwertner, who has been responsible for quite a few important projects, believes that this latest model should well answer the purposes of any job, and that it overcomes most of the difficulties experienced by other contractors with the hoist designs used by them.

Mr. Schwertner has here developed a sectional hoist that is erected in story-units in such a way that it can easily be carried one story above the floor that has just been completed. This is accomplished by a simple bracing arrangement that affords absolute rigidity. With the unit system, it is easy for two men to lengthen the hoist one story in two hours time. To do this, a gin pole is first set up, then the head frame is hoisted, and the unit panel frame is hoisted in place and spliced in between the head frame and the lower unit. Next, a new set of tie girders are bolted to the frame and to the finished floor. For this purpose, it is the custom to cast the bolts in the floor at the time the concrete is placed. The next step calls for erecting the braces, and the hoist is ready for use on the next floor, delivering the form lumber and then the reinforcement for the floor slab as soon as the column forms or shoring are ready for that stage of operation.

Note that the skip runs between guides and that the face that must withstand this friction is shod with a 4-inch channel iron covering the wood core. Frame and skip are built with standard timbers of long-leaf yellow pine, obtainable anywhere, and standard hardware is used throughout.

Concrete Trap Removes Oil from Waste Water

For the purpose of removing all oil from waste water at the plant of the Associated Oil Company in Alameda, a concrete oil trap has been built in the form of a sump with the top of the concrete walls on a level with the ground. All waste oil and all water and steam from the plant is delivered into this trap, which is equipped with baffle plates with two-inch pipes in the baffle plates for connecting the compartments into which the sump is divided. As the oil rises to the top of the water it is pumped out by the pipes at the left of the sump. When the water passes out at the end of the last compartment it is practically free from all traces of oil. This not only complies with the state law prohibiting oil from being allowed to run into the bay of San Francisco, but saves considerable oil which otherwise would be lost.



Court Sustains Patent for Concrete Placer

The Concrete Mixing and Conveying Company have recently won a decision in the United States District Court, Southern District of New York, against Powers-Kennedy Contracting Corporation and Anthony G. Fleck, restraining their use of what is known as the McMichael Patent for Pneumatic Concrete Placers.

By a previous decision in the United States District Court, later affirmed by the United States Circuit Court of Appeals, the right to manufacture concrete apparatus adapted to placing concrete pneumatically at a distance from the mixer—as in tunnels, foundation work, piers, etc.—is virtually restricted to the holder of the McMichael Patent and their sole licensee, the Ransome Concrete Machinery Company, Dunellen, N. J.

An Interesting Series of Tests

Unusually Complete Tests Given Concrete Masonry Units

RECENTLY there were completed by the Thermotite Construction Company at San Jose, California, an extremely interesting series of tests on Thermotite concrete units and wall construction. The complete series, conducted in the company's plant, consisted of fire exposure, crushing and beam tests, comprising one of the most comprehensive demonstrations yet given in the interests of any type of concrete masonry.

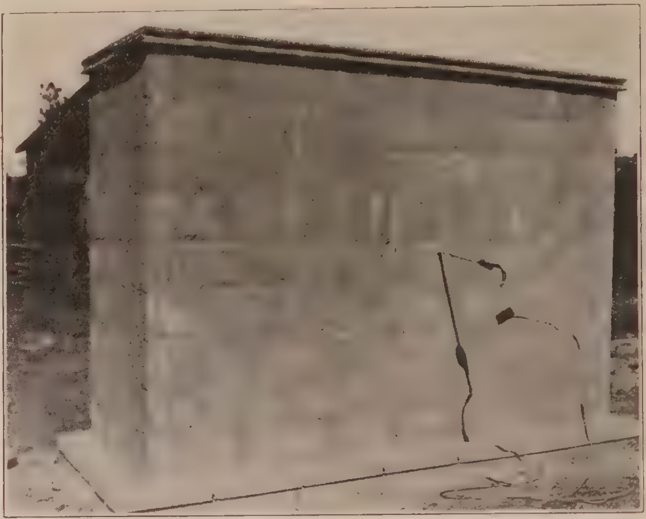
Thermotite units are solid slabs with 8 inch by 16 inch faces made in thickness of 2½ to 4 inches in order to take care of a variation of loading requirements. All of the edges are tongue-and-grooved. The weight of individual units ranges from 26 pounds for the 2½ inch thickness to 41 pounds for the 4 inch thickness. In construction two parallel walls of these units are laid up with an air space (commonly ranging from 2 inches to 16 inches) between. The air space is bridged at intervals of 16 inches in every second or third course with heavily galvanized punched steel ties in addition to which diagonal stiffeners are occasionally used. These ties are made of No. 22 gauge material one inch wide, rolled into a semicircle ⅝-inch in diameter.

Fire Demonstration

The fire test was a very severe one, in which temperatures much in excess of those reached in ordinary building fires were obtained. A wall panel 6 feet in height was constructed as shown in the accompanying illustrations, having two wing walls forming a fire place. The wall was 10½ inches thick, having been laid up of two rows of units 2½ inches thick with a 5½ inch air space between. A trench of concrete, of 75 gallons capacity, was provided within the space formed in front of the wall, for the fuel, consisting of kerosene. The sewer pipes shown were provided to aid in supplying draft. An electro thermo-couple pyrometer, used to measure the temperatures was inserted in the center of the panel. An ordinary thermometer was attached to the rear surface of the wall.

The front end of the test panel, after the fire had been burning for 20 minutes

The oil was ignited by Chief H. W. Hobson, of the San Jose fire department at 2 p. m. and the heat became intense on the front side of the wall almost immediately. The temperature readings on both sides of the wall, taken at ten minute intervals were as follows:



Rear view of the test panel, showing the pyrometer couple extending through the wall. Note also the thermometer fastened to the rear wall

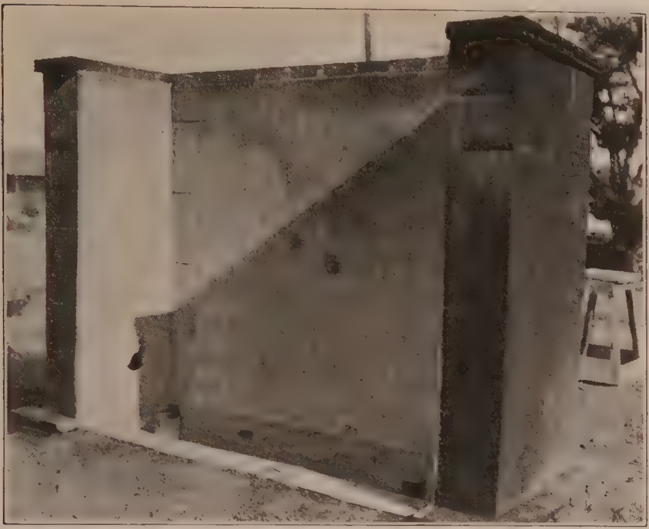
Observed Temperatures

Duration of Fire	Normal Atmospheric Temperature	Outside (Back) of Wall Panel	Inside (Front) of Wall Panel
0 minutes	87-deg.	90-deg.	90-deg.
10 "	87 "	98 "	958 "
20 "	88 "	100 "	1102 "
30 "	90 "	106 "	1058 "
40 "	84 "	108 "	1012 "
50 "	84 "	108 "	1012 "
60 "	84 "	104 "	508 "

All of the readings were observed and recorded by Fire Chief Hobson. After an exposure of one hour a ¾-inch hose stream was turned on the hot wall, which was cooled as rapidly as possible without any spalling of the material whatever. Later the wall was dismembered for careful examination throughout. The blocks were found to be structurally sound and to have suffered only slight disintegration on surfaces subjected to most intense exposure.

Results of this test were undoubtedly better than could have been predicted in at least one particular. The shape of the panel, with substantial and almost immovable end wings, might have been expected to promote the formation of wall cracks at the junction of the end walls as the main face expanded. In fact it seems certain that parts of the construction must have been called upon to withstand very severe stresses from this and other causes. Also, the uneven distribution of heat must have produced effects more trying on the blocks and on the wall assembly than is the case where a plain flat panel is subjected to a relatively even distribution of heat over its surface, as is the case in the ordinary laboratory fire test.

The evidence developed in this test, on a type of concrete masonry wall construction not heretofore tested, not only indicates that such walls afford a safe margin of fireproofness but adds another bit of conclusive testimony to the results of various recent tests indicating that concrete masonry as a general type is unrivaled as a fire retardant.

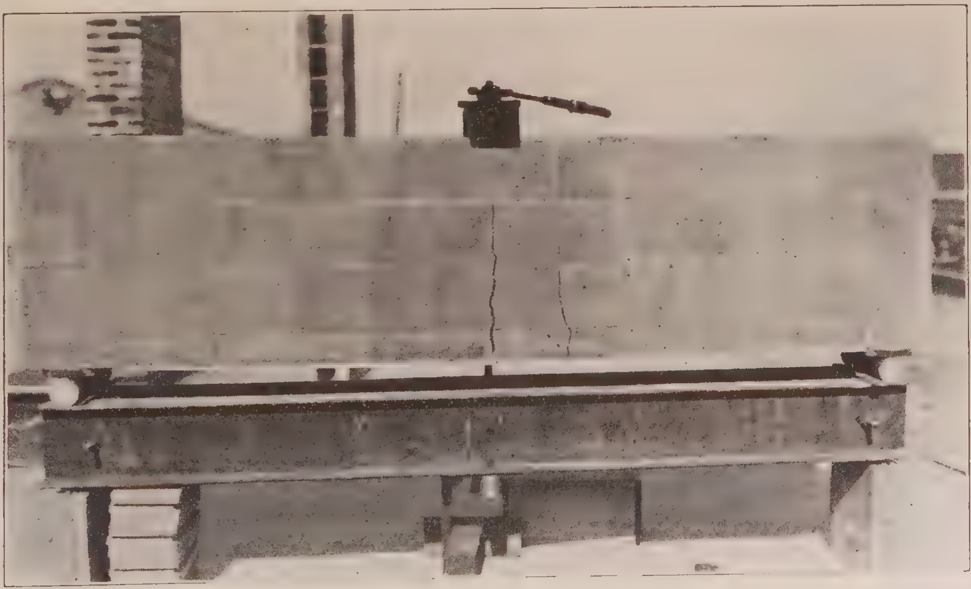


The inside of the "fire place" after the fire. The holes shown were driven through with a pick to note the effect of the fire on the interior of the wall

Crushing Test

Crushing tests of full size wall sections are unusual and of great interest. In this particular test the wall section was laid face down on a plain, level area, in such a manner that the section of outer wall was directly over the corresponding section of inner wall, being separated from it only by the metal ties previously described. The object of the test is to observe the efficiency of these ties in compression and as wall stiffeners.

With 129 sacks piled on the wall, the load started to over balance. The wall was afterward crushed by loading it with concrete units. It took a load of 17,862 pounds to crush the ties



The beam after it failed. Note that the breaks did not follow the joints. The load at time of failure was 13,000 pounds

The wall section used was 4 feet by 4 feet, consisting of outer and inner walls of solid units 3 inches thick with an open space 7 inches in width between walls. Inner and outer walls were separated by 28 horizontal ties and 20 diagonal ties, the latter placed in two rows corresponding in spacing and arrangement with that used in practice. When the specimen was ready for test the ties occupied a vertical or diagonal position.

One hundred twenty-nine sacks of cement weighing 12,200 pounds were loaded onto the section in an effort to crush it by causing failures of the ties or stiffeners, however, the load began to overbalance and the cement sack test had to be discontinued at that point. Later the section was loaded with concrete units until collapse occurred with a load of 17,862 pounds or 1116 pounds per square foot. This would indicate a wide margin of stability when the great overall thickness of these walls is considered.

Beam Tests

For the beam test shown in an accompanying illustration a section of wall 9 feet 4 inches long was constructed, using units 2½ inches thick, spaced 7½ inches apart so as to give an overall width of 12½ inches. The beam had a depth of 3½ courses, equal to 28 inches. The two semispherical points of support were placed 8 feet 6 inches apart.

Two longitudinal reinforcing bars, ¼x¼-inch were placed in the mortar joint 4 inches above the bottom of the beam and two more similar bars in the joint 12 inches above the bottom. The usual ⅝-inch galvanized ties were used in each course at intervals of 16 inches. At a loading of 13,000 pounds applied at the mid-point, the beam failed in tension, cracks opening from the bottom almost to the top of the beam. The reinforcing held while the load was increased to 17,000 pounds.

Somewhat similar tests were made of corresponding sections of clay brick and thermotite wall erected in vertical position. These tests simulated side thrust as applied to ordinary building walls. Pressure was applied at the center of the panel and distributed over the entire width while resistance was provided by support points at top and bottom.

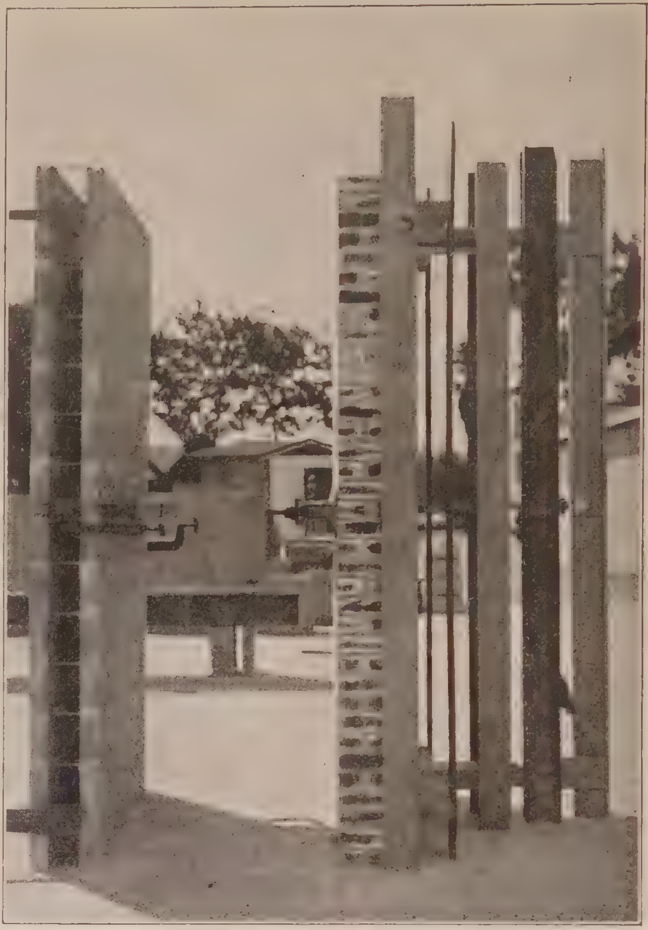
The clay brick wall panel was 9 feet 4 inches high 4 feet in width and 12½ inches in thickness, consisting of three rows of brick. The wall was laid up under the supervision of M. C. Woodruff, Building Inspector of San Jose, the masonry being 25 days old at time of test. Failure of the beam occurred in tension on a horizontal joint at a loading of 2100 pounds. The deflection of the specimen at center for the maximum loading was .047 inches, being slightly less than the deflection of the two 6-inch channels (with 8 foot 6 inch span) through which the load was applied.

A corresponding test was then made on a section of Thermotite wall of the same width (4 feet) and height (9 feet 4 inches) as the clay brick panel just described. The Thermotite panel was constructed of double walls of units 3 inches thick, with a 5-inch air space between, giving a wall thickness of 11 inches over all. The usual wall ties 1 inch wide, rolled to ⅝-inch diameter, of No. 22 heavily galvanized steel were used 16 inches apart in each horizontal mortar joint. Horizontal joints are 8 inches center to center. In two of the joints double diagonal ties were used in the same manner as in the specimen described earlier, which was tested flatwise.

Panel Tests

The concrete wall panel was of the same age as the clay brick panel when tested and the same methods of laying and testing were employed throughout. The specimen failed in tension on a transverse joint at a loading of 3600 pounds which was 1500 pounds in excess of the load on the clay brick panel at failure. The concrete specimen showed its superior stability by sustaining a load 170 per cent of the maximum sustained by the clay brick wall. Deflection of the concrete specimen at maximum loading was .112 inches.

The method of applying the loadings in all of these beam tests was the same—by tightening a large nut on a one-inch rod. Extensometers were used to measure the deflection of the concrete specimens and the steel beams to which they were attached. Professor Charles Moser of the engineering department of Leland Stanford University observed the tests throughout and has reported them in full.



Showing the arrangement used for making tests against stresses similar to side thrust as applied to building walls

The foregoing tests were arranged by the manufacturers, the Thermotite Construction Company of San Jose, largely for the purpose of providing a practical non-technical series of public demonstrations which would bring out the various desirable features of this type of construction. Where comparison was made with other types it was merely for the purpose of securing a method of measuring the concrete type without any desire to belittle the obvious usefulness of other materials.

W. O. Winston, First Head of A. G. C., Dies

W. O. Winston, dean of the general contractors of the United States, died at Los Angeles, California, March 15, at the age of seventy-four years.

Mr. Winston was president of the Winston-Dear Company and chairman of the board of directors of Winston Brothers Company, Minneapolis. He was the first president of the Associated General Contractors of America and had been active in the affairs of the contractors' national association since its organization. Mr. Winston recently had celebrated the fiftieth anniversary of the award of his first contract.

Selling Concrete Septic Tanks

How an Aggressive Merchandising Plan Brought Orders

"Selling concrete products is a subject that interests all of us vitally," said Wm. H. De Lhorbe, a products manufacturer at Oregon, Ill., when that question came up for discussion recently. "I have had some interesting experiences in marketing septic tanks. Some of my methods were successful and some were not."

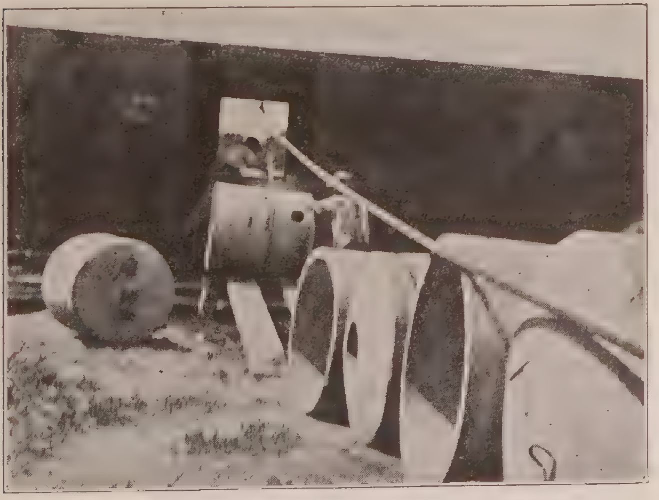
The methods used by Mr. DeLhrobe are described in this article. While they apply to merchandising of concrete septic tanks, the same principles applied to the sale of other concrete products will be equally effective.

"FIRST of all," advises Mr. DeLhorbe, "you must know your product. You will find that your best buyers are men who are well informed about the product you are selling. You must inspire confidence by convincing the prospect that you know what you are talking about. This principle applies to the selling of concrete silos, block, septic tanks or dress shirts.

"It would be ridiculous to lay down any definite line for the salesman to follow or to write a little story for him to speak when he meets his prospect. Each situation must be met in its own way when it arises."

Let the Plumber Do It

"At first we imagined that the plumber would be the logical man to market our septic tanks, as the undertaker markets our burial vaults. In line with this policy, we printed 5,000 circulars and called on all the plumbers in the villages and towns in our territory, giving each plumber a supply of the circulars and offering him a handsome commission for every tank he sold.



Loading car with septic tanks—after selling direct

"Then we sat down and waited. This seemed easy to do, but the orders from the plumbers did not materialize.

"Later we went to Chicago and listed our septic tanks with some of the nationally known jobbers, but still the orders did not come. Some other plan was needed.

Selling Direct

"Something surely was wrong about this method. Our business was increasing in every branch where we were selling direct to the customer. I had a record of the sale of several hundred silos and surely I could sell septic tanks. Then I got aboard the old Ford and started to find out where the trouble was. To my surprise, I found that most people did not even know what a septic tank was.

"That meant the education of the people in our territory through advertising, and plenty of it. Our county fair was about to open and I took a booth on the fair grounds. In it I put a complete septic tank outfit, even to the plumbing and the stool. We distributed 10,000 circulars at that fair.

A group of tanks curing in the yard at Oregon, Ill.

A New Plan

"With this background, we started out to *sell*.

"I would pick out a small town without a public sewer system—say, like Erie, Ill., a village of about 900 inhabitants. The first man I called on was a banker, who also was the mayor of the village. I told him what I intended to do for the sanitation of the town and showed him my tanks. I told him I wanted him as the first man on my order book, as I intended to sell a carload of septic tanks in Erie. Before I left the bank I had sold him and one of his clerks. Then I found out who the doctor was that represented the board of health and went to him and sold him.

"I had 700 circulars with me. I started down the street, handing one of them to every man and woman I met. I put them in the farmers' cars and wagons. I then left a circular at every house in town. This required a full day of hard work, but I was rewarded in the evening, for three men came to the hotel and bought septic tanks. At the end of two and a half days I left for home with orders in my pocket for 13 septic tanks, which made a full carload shipment.

"Since then I have tried the same tactics or variations of this plan in other places with equal success. This fact cannot be disputed: That if you get busy and *sell* you can get orders. They will not come by sitting back and letting the other fellow do it."

Here and There

Some Random Notes on Visits with Concretors in the Field

MERCHANDISING is the subject uppermost in the mind of the concrete products manufacturer today. No matter how good a product he makes, if he does not sell it, there is no profit. The success or failure of the concrete masonry unit in the next few years depends largely on how well the products manufacturer is going to merchandise his wares.

* * *

ONE block manufacturer, who incidentally makes a darn good product, has hit on an idea that might help in this matter of selling. In the first place, this man employs salesmen whose *only* job it is to sell. Besides handling block, he sells about twenty different permanent building materials, such as reinforcing, metal window frames, metal lath, etc.

As his salesmen visit contractors and architects, they get lots of leads for possible concrete block sales. Also, by handling these specialties, they make valuable contacts with architects that often lead to conversions for concrete masonry units. While the salesman is calling on a prospect for metal window frames, for instance, he never misses an opportunity to tell of the advantages of the concrete block as a building material. In that way, the salesman can do a lot of valuable promotional work at a low cost.

Such a plan might help sell your block.

* * *

ANOTHER products manufacturer passes on this little sales help. He makes concrete septic tanks. Every tank he sells has his name and address on it. When they are in transit or waiting delivery on the station platforms they attract attention and interest and this manufacturer can trace a number of sales definitely to this practice.

* * *

HERE is a concrete block manufacturer who went all the way in supplying construction service to his customers. He not only made concrete block and sold other permanent building materials, but he also operated a retail store in which he sold hardware, stoves, etc. In his warehouse he carries a supply of concrete mixers and he sells three or four carloads of them each year to his contractor friends. When the contractors have an emergency use for an extra mixer, this products manufacturer will rent them one from the mixers he keeps on hand for this purpose.

This products manufacturer is rendering the builders in his community a real service by making it possible for them to buy all their building materials and equipment from a single place.

* * *

MEMBERSHIP in the Guild of Certified Slump Testers is growing apace. If you are qualified for membership, send in your application at once. You will find some interesting facts about this unique organization in the Mixer Musings column.

CONCRETE trim stone is growing in popularity. Another skyscraper in the Chicago loop district is depending on concrete cast stone for ornamentation and for veneer for the first six stories. Not only is concrete stone used for the exterior, but much of the interior work for which marble is usually used will be done in cast stone.

There is a large undeveloped field for ornamental cast stone in your city, too.

* * *

TIME as a factor in placing concrete, was a subject on which there were some extremely interesting discussions at the recent A. C. I. meeting. It is reasonable to maintain that the amount of water in the mix at the time the concrete is in the forms or on the subgrade is the amount that determines the strength of the concrete according to the water-cement ratio law. Often the consistency of the concrete in the mixer and its consistency just before it begins to harden are two very different things. If you mix and place your concrete with a certain amount of water and then remove the excess water before the hardening process has begun, you are following good practice in the light of the water-cement ratio law.

* * *

DON'T overtell your story, warns the *Wisconsin Concrete Products Digest.*

While it is generally hard to get enough time to sell your product, still there are times when you are liable to unsell it. It is well to say enough, but not too much. Let your arguments and ideas get a chance to work a little. Leave a little of the talking to the one you are trying to sell.

Usually if your product is right and your prospect is in the field, he will help sell himself if you will let him.

* * *

WE will make anything that can be made of concrete," said one progressive products manufacturer. He specializes on trim stone and the stuff in the yard certainly did look good. Instead of trying to tell the architects what they ought to want, this wise bird concentrates on letting the architect make up his own mind and then producing the kind of stone he wants. As a result, the architects like to work with him and he is working up a dandy business in high-grade trim stone.

* * *

ORNAMENTAL concrete garden furniture is an important part of the production of a progressive products manufacturer. This man solved the problem of merchandising his garden furniture in a very successful way. He maintains a permanent exhibit of his products in the leading department store of his city. Occasionally, especially in the spring when men's thoughts turn to their gardens, he arranges to have the concrete benches, bird baths, sun dial pedestals, etc., displayed in a window along with other garden equipment, such as sprinklers, lawnmowers, etc. The scheme works fine, and he has no trouble disposing of all the products he can manufacture. He simply sized up the situation and then made the most of the marketing opportunities that offered.

Commercial Mixing Plant Turns Out 1,000 Cubic Yards of Concrete Daily

Pittsburgh Plant Sells Ready-Mixed Concrete of Any Mix in Any Quantity — A Successful Business Venture

FREQUENTLY as much as one thousand cubic yards of concrete, already prepared for the forms, is turned out in one day at the plant of the Ready Mixed Concrete Company of Pittsburgh, a plant which is said to be the largest in the world.

The plant consists of two mixers, one of 25 yards per hour capacity and the other of 75 cubic yards per hour capacity. That the company has faith in the product which it makes is demonstrated by the use of concrete around the plant, for all structures are built of this material. The most important building is the concrete structure in which the larger mixer is housed. This building is so arranged that trucks are loaded by gravity and the mixer is supplied with raw materials by this same convenient force of nature. The first story is devoted to truck space. The second floor, of course, carries the mixer, the third the measuring devices and operating platform, while the top story houses an ample supply of aggregates.

Delivery Service Important

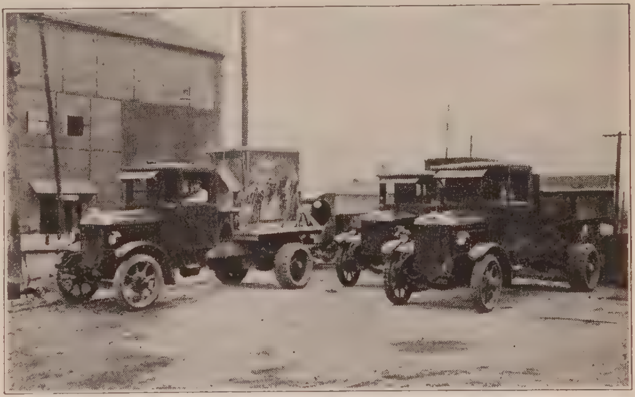
Edward N. Jones, president of the company, declares that the success of a central commercial plant depends not only on the quality of the product but also on the dependability of the delivery service. To assure the customers of this plant such service a fleet of 10 five-ton trucks has been placed in operation. Eight of these trucks are equipped with three-yard bottom dump buckets which provide means for accurate and efficient dumping. But more than that, the use of this particular type of bucket permits the successful transportation of concrete of slumps of up to six or seven inches. So far as is known this Pittsburgh company is the only one using this type of bucket.

The large mixer is housed in this building. The first floor is devoted to truck space, the second supports the mixer, the third is equipped with measuring devices and the fourth provides storage for aggregates

The other two trucks have tapered bodies which are elevated by highway hoists. These trucks are used for stiffer mixtures.

Ready Mixed Concrete in Demand

The smaller unit of this plant was placed in operation in May, 1925. The business rapidly increased and when the larger unit was added a year later the two mixers were kept comfortably occupied. Lately the plant has been averaging between 20 and 30 different jobs daily. Most of the concrete, of course, goes into small building construction but frequently contractors for larger projects call on this central plant. Recently a large portion of the output was used in repaving conduit excavations made by public utility concerns. Large yardages have been devoted to retaining walls and bridges. It is striking that only a comparatively small amount of concrete from this plant has gone into reinforced construction. This company also does quite a business in supplying lime mortar.



Adequate delivery facilities are important. This plant is served by a fleet of ten trucks, eight of which are equipped with special bottom dumping devices

"The central commercial mixing plant is coming into its own," declares Mr. Jones, who has long been interested in building construction in Pittsburgh. He asserts, "It has only been a short time since the central mixing plant was an experiment, nothing much more than a side line with some venturesome contractor or building material dealer. The operation of such a plant is now a full time business.

A general view of the plant of the Ready Mixed Concrete Company, of Pittsburgh. In the background is the smaller mixer, while the new, 75 yard per hour mixer is installed in the concrete building in the foreground

By a little figuring the builder will oftentimes convince himself that he will save money by patronizing the commercial plant. To move a portable mixer about from job to job costs money. Aggregates are also a source of worry. Where sand and stone must be hauled any considerable distance it is much cheaper to buy ready mixed concrete, thereby reducing hauling costs which in many cases eat up all profits.

"By its very nature the business of furnishing the public with ready-mixed concrete keeps us on our toes. As we have no way of reading the building public's mind we must be ready at a moment's notice to make concrete in varying quantities and mixes. The arrangement of the building in which the large mixer is housed makes it possible, however, for us to readily supply concrete for a doorstep, a city street or an office building.

"Pioneering in business is certainly interesting. Not long ago a voice on the telephone asked if he were talking to the 'Mix 'em Up Concrete Company'. Recently a woman's voice queried if this was the Mixed Up Concrete Company. She ordered 30 yards of concrete. When our delivery man arrived at the woman's home with the first load he found that 30 cubic feet, not yards, would be enough."

Many Plants in Operation

Some of the cities which now have commercial mixing plants are: Seattle, Wash., Kankakee, Urbana, Bloomington, Danville, Galesburg and Wood River, Ill., Little Rock, Ark., Houston, Fort Worth and Wichita Falls, Tex., San Mateo, Santa Ana, and Los Angeles, Calif., Sioux City, Des Moines, Pittsburgh, Philadelphia, Birmingham, New Orleans, Columbus, Youngstown and Indianapolis.

Practically all of these plants have been successful, even those which are located in towns of only a few thousand population. This indicates that within a short time the commercial central mixing plant will be common—not as common as the cigar store, but nevertheless, it will be possible for the builder to obtain a ready-to-use product in almost any populous community.

Chemically Purified Cinder Block, Brick and Tile Now Manufactured Under Cordery Patents

Chemical purification of cinder block is a characteristic of the Cordery patents, under which some cinder products are now being made. The process consists of injecting into the mix with the mixing water a pre-determined quantity of chemical. The treatment neutralizes the free agents which abound in raw clinker.

Block, brick or tile are said not to blister or crumble, nor to be subject to dry rot. Stucco may be applied directly to the outside surface, and plaster to the inside surface, without the use of furring or lath. Nails and screws may be driven into it, and hold with tenacity equal to wood.

Cordery Cinder Products, Incorporated, Passaic, New Jersey, has been organized to dispose of licenses to manufacturers.

Some Further Notes on Uses and Characteristics of Lumnite Cement

Properties of High Alumina Cement Explained — Detailed Directions for Its Use Given — Precautions to be Observed

By JOSHUA L. MINER
Technical Manager, Atlas Lumnite Cement Company

SOME time ago (February, 1925) "Concrete" published some notes on the uses and characteristics of American alumina cement. The article described many of the properties of this kind of cement as at that time developed by laboratory test and experience in the field with an American made alumina cement. This article is a continuation of those notes recounting data and information since developed through additional experience.

THE use of high alumina cement has not been competitive with portland cement but has been an ally, facilitating the solution of many concrete problems by removing some of the delays and eliminating some of the objections sometimes made to concrete work.

Conditions are sometimes encountered under which a special cement of peculiar quality and characteristics would materially aid in the solution of a difficult construction problem, a part of a considerable project, the progress of which would be facilitated and economies effected through the elimination of delay.

The peculiar cementing quality which most frequently aids in the solution of special construction problems is that of rapid hardening. Frequently, in concrete construction a part or all of the work has to wait until some piece of concrete has developed sufficient strength for the work to proceed. The rapid hardening properties of high alumina cement, developing over night a 28-day concrete, has eliminated this "neck of the bottle" on many construction jobs.

For example, the use of a small quantity of this cement permitted a million dollar group of improvements to be used twenty days sooner than anticipated. The construction consisted of a system of concrete roadways running throughout a section of a large meat packing plant at the second floor level. The contractors had completed the entire system, except a short connecting bridge span of 22 feet. This short span was built with Lumnite, which because of its rapid hardening and high early strength effected a saving of twenty days time and thus permitted the use of the entire group of improvements that much earlier.

The element of time may not be of equal importance on every job, but it is present at one time or another in every type of concrete construction and this outstanding feature of rapid hardening and high early strength, fills one of the demands on concrete construction that portland cement is unable to meet, either alone or in any combination so far developed.

Laboratory Tests

The following compressive strength results obtained by the Pittsburgh Testing Laboratory on standard 1:3 mortars give some idea of this rapid hardening of Lumnite cement:

Hours After Mixing	Pounds Per Square Inch
6	542
9	2486
10	2785
11	2908
12	3442
13	3582
14	3958
15	4054
18	4208
21	4434
24	4817

E. L. Conwell & Company of Philadelphia have reported the following compressive strength results on field mixed 1:2:4 Lumnite cement concrete sampled and tested in connection with some construction work in Philadelphia:

Hours After Mixing	Pounds Per Square Inch
14	2334
16	2461
18	2595
20	2851
24	3138
36	3267

Since its introduction it has been used in the construction of highways, buildings, bridges, sea water structures, floors, machine and engine foundations, retaining walls, underpinning, heavy foundations, piles, tanks, vats, sewers, in the manufacture of pipe and various concrete products, and in the cementing of oil wells.

Lumnite cement is not a portland cement. It differs in chemical composition and in its physical properties. Al-

Correction

In an article published in the February issue of CONCRETE under the title "Railroads Use Quick Hardening Cement for Winter Rush Work," the statement was made that high alumina "concrete hardens rapidly so that the strength at three days equals the strength of standard portland cement at 28 days."

This was an error. High alumina cement develops strength in 24 hours equal to that ordinarily attained by standard portland cement in 28 days.

though it is used for the same purposes and when mixed with sand, stone and water will harden to form concrete, it does not follow that it should and can be used in exactly the same way as some are accustomed to use portland cement. In general, however, it can be stated that when alumina cement is used in accordance with the best practices in the art of making concrete, as recommended for portland cement and with due allowance for more rapid hardening, satisfactory results will follow.

Mixing Water Important

The amount of mixing water used is most important. When mixed with water, the cement becomes a "glue" which upon hardening binds together particles of sand and stone. An excess of mixing water dilutes this "glue," lowering its strength, increasing its porosity and decreasing its durability, especially its resistance to the action of moisture and changes of temperatures, with much the same results as follow when fish glue is diluted with too much water.

The following results illustrate the effect of the amount of mixing water on the strength of Lumnite cement concrete.

Twenty-four hour compressive strength results by the North Carolina State Highway laboratory on 1:2:4 Lumnite cement concrete:

Water cement ratio	.70	.80	1.00	1.25
Gals. of water per bag of cement	5.26	6.0	7.53	9.41
Average Compressive Strengths lbs. per sq. in.	5253	4468	3258	1809

Excess mixing water occupies space and holds apart particles of aggregate thus decreasing the density of the concrete. When the concrete has hardened voids remain. These permit of the more rapid attack of moisture and frost which, if conditions are right, will rapidly destroy the concrete.

The shrinkage or contraction during hardening of concrete mixed with an excess of water is greater than that of the drier mixed concretes. Further, wet mixed concretes after hardening have higher co-efficients of expansion and contraction.

Mixed with an excess of mixing water, concrete is considerably less resistant to the chemical attack of moisture. This is not peculiar to Lumnite cement alone for Mr. D. G. Miler, Drainage Engineer, United States Bureau of Public Roads, has stated in connection with his study of the action of sulphate waters on concrete (Public Roads, October, 1925), "the relative consistency of 1 is as wet as can be used in machine molded tile and it has been found that consistencies greatly varying from this are considerably less resistant." This effect of the quantity of mixing water on durability is especially important in marine construction and in fact in all work where the concrete is alternately wet and dry or subject to water under pressure.

It is recommended that the amount of mixing water be limited to the least amount that will give a plastic workable concrete. One investigator has recommended limiting the amount to that quantity which will give a plastic workable concrete of the maximum weight per cubic foot. Users have found that for most purposes from 5 to 7 gallons of water per bag of cement, including the moisture in the aggregates, will give satisfactory results and are sufficient for concrete made of well graded, properly proportioned aggregates. For mortars, less than 5 gallons per bag of cement, including the moisture in the sand, is sufficient.

In measuring the amount of water to be added at the mixer, due allowance must be made for the moisture contained in the aggregates. This is considerable and may amount to as much as 5 gallons in the sand and stone required for a one-bag batch of 1:2:4 concrete.

Moisture in Aggregates

Very often the plasticity of the concrete can be improved with an accompanying decrease in the required amount of mixing water by varying the ratio of fine to coarse aggregates. On one job it was noted that 11 gallons of water per bag of cement were being added at the mixer. By increasing the quantity of sand and slightly decreasing the amount of coarse aggregate, a concrete of much better plasticity and workability was obtained with less than 5 gallons of water per bag of cement.

To give some idea of how much moisture there may be in the aggregates used with one bag of cement and how much this may vary in the same quantities of aggregates, the following table is quoted from CONCRETE, December, 1926.

Because of variations in the moisture content of aggregates and different weights per cubic foot for other aggregates, the values in this table are necessarily approximations and only intended to indicate what may be found under average conditions.

Weight of fine aggregate per cubic foot..........100 pounds
Weight of coarse aggregate per cubic foot........100 pounds

Moisture in Fine Aggregate

Condition of Aggregate	Gal. per Cu. Ft.	Per Cent
Dry	.238	2
Damp	.595	5
Wet	1.071	9

Moisture in Coarse Aggregate

Condition of Aggregate	Gal. per Cu. Ft.	Per Cent
Dry	.000	0
Damp	.119	1
Wet	.357	3

Total Moisture in Gallons Contained in Aggregates Required for a One-Bag Batch for Mixes Shown

Condition of Aggregates	1:2½	1:3	1:2:3	1:2:3½	1:2:4	1:2½:5	1:3:6
Dry	.6	.8	.5	.5	.5	.6	.7
Damp	1.5	1.8	1.5	1.6	1.7	2.1	2.5
Wet	2.7	3.2	3.2	3.4	3.6	4.6	5.3

Heat Developed

The heat developed by Lumnite cement while hardening is of advantage in cold weather construction. The rapid hydration or early hardening brings the concrete in a few hours to a point in its curing beyond the danger of frost attack. The heat developed by the cement, especially in large masses, is usually sufficient to resist the retarding effect of cold temperatures.

In moderately cold weather Lumnite concrete needs protection only until the cement takes its initial set, that is, becomes hard and even in extremely cold weather protection is necessary only during the first 24 hours.

The following conclusion is quoted from the Michigan State College Bulletin No. 4, "Some Properties of Lumnite Cement."

"On construction work where the type of structure does not admit of an enclosure, as in the case of isolated footings, foundations, pavement slabs, etc., it is sufficient to use a covering which insulates the concrete from the freezing temperature at least for the first seven hours, and retain the heat developed within the concrete during the rapid hydration of the cement."

In using alumina cement in cold weather, heat should be used only to avoid freezing temperatures. The aggregates should be free from frost but not overheated. Better results are obtained if the concrete is at normal temperature (50 to 70°F.) when it leaves the mixer.

Because of its rapid hardening, Lumnite requires all of its curing during the first twenty-four hours. Curing water serves two purposes. It replaces the water lost from the exposed surface of the concrete by evaporation, which water is necessary for the hydration of the cement in the concrete near the surface. Secondly, through the free evaporation of this surface water, the heat generated by the cement while hardening is more rapidly dissipated.

Curing water should be applied to all exposed surfaces as soon as the concrete is hard enough to resist the washing effect of water. The surfaces should then be kept wet until twenty-four hours after the concrete was placed. Curing water should not be applied too soon or otherwise it will mix with the cement near the surface and have the same effect as too much mixing water. For the same reason it should not be applied too freely at the start. Under average conditions curing water will be required about six hours after mixing. In warm dry weather it may be required before six hours and in cold damp weather as late as ten or twelve hours.

Curing water should be flowed on, sprinkled or sprayed. Wet coverings, such as burlap, sawdust or sand, should not be used as they tend to retain the heat developed in the concrete and thus lower the surface strength and frequently cause dusting.

In very hot weather it may be necessary to protect exposed surfaces of freshly placed concrete from the direct rays of the sun in order to avoid too rapid drying out. Under such conditions contractors have found it expedient to cover the concrete with wet burlap or other material, which is removed as soon as the concrete begins to develop heat or is sufficiently hard to resist the washing effect of curing water.

Storage Precautions

Lumnite cement is a finely pulverized material. Like other hydraulic cements it is hydroscopic, that is, it will absorb moisture from the air. Although it is shipped in multi-wall paper bags that are highly resistant to the penetration of moisture or in paper-lined cloth bags, it will slowly absorb moisture during long time storage; especially if stored in localities subject to fogs and moist atmospheric conditions.

Twenty-four hours after pouring this concrete pit in a C. & O. round-house with Lumnite concrete it safely carried a 288-ton locomotive

Tests made on some cement that had been in storage a year showed no effect of age. Samples from cement under other storage conditions have shown deterioration in three months' time. It is recommended that Lumnite cement in storage be given the same careful protection against the absorption of moisture and pressure caking recommended for portland cement.

Other cements, limes, anti-freezing compounds, accelerators, and soluble compounds in general must not be mixed with Lumnite cement, at least without test to ascertain the effect of such admixtures on the cement. Many admixtures contain lime in soluble form which react unsatisfactorily with Lumnite cement, generally lowering the strength and frequently causing quick set.

Mineral pigments employed in the coloring of concrete have been used successfully. It is suggested, however, that before using a new material it be tried out with Lumnite, because many of these coloring materials often contain soluble lime compounds.

Proportions Recommended

The proportions of a mix will vary with the character of the aggregates and the requirements of the work.

Rich mixes, especially in large masses, should not be used. Experience has shown that the heat generated by the cement while hardening in rich mixes, especially in large masses, is frequently sufficient to cause surface shrinkage cracks. Where the heat developed by the cement is not freely dissipated, it may be sufficient through over-acceleration to lower the strength of the concrete.

Users have found that mortar mixes richer than 1:2½ generally do not give the best results in floor toppings, sidewalk finishes or other uses; and that concrete mixes approximately 1:2:4 are sufficiently rich for most purposes. In road slabs, precast piles and other relatively small masses mixes as rich as 1:2:3 have been successfully used.

Effect of Heat

The hardening of hydraulic cements is a chemical action. Heat accelerates this action. Lumnite cement stored near heat or in hot weather in the direct rays of the sun may absorb enough heat to overaccelerate its hardening to such an extent as to lower its strength, decrease its durability and often cause it to become quick setting, sometimes even "flash setting" in the mixer.

Steam curing or heating to hasten the hardening of Lumnite should never be used. In winter only sufficient heat should be employed to keep the concrete from freezing. In hot weather, especially in tropical countries, it is recommended that the cement be stored in a cool place and protected from the direct rays of the sun, either in storage or when piled at the work. Under very warm atmospheric conditions it is further recommended that the sand and stone be cooled by sprinkling and if possible protected from the direct rays of the sun.

An interesting example of the effect of heat on Lumnite cement concrete while hardening, is found in the following tests made on concrete blocks manufactured from the same batch of concrete. These results are in pounds per square inch, per gross area of the blocks. No allowance has been made for the cellular openings in these blocks.

Age in Days	Cured in steam 100 to 110°F.	Cured out of doors Approximately 60°F.
1 day	972	1597
2 days	768	1830
7 days	1180	1860
28 days	1150	2140

The heat developed by Lumnite cement test specimens when stored in moist closets may be sufficient to raise the temperature of the air in such closets above normal and to produce a drying out condition in the moist closet. Such a condition will lower the strength of the test specimens and frequently cause surface shrinkage cracks.

Strength of Bond to Steel

Columbia University reports the following results in determining the strength of bond of Lumnite cement concrete and steel. Tests were made on ¾ inch plain rods imbedded full length in 8x12-inch cylinders of 1:2:4 Lumnite cement concrete.

Bond stress at first slip—599 pounds per square inch
Ultimate bond stress —694 " " " "

Modulus of Rupture

Average of six tests by Columbia University on 4x4x18-inch specimens 1:2:4 Lumnite cement concrete developed a modulus of rupture of 856 pounds per square inch at twenty-four hours.

Pennsylvania State Highway Laboratory reported the following moduli of rupture results on a beam 6 inches wide, 8 inches high and 24-inch span, mix 1:2:3.

24 hours—944 pounds per square inch
2 days —929 " " " "
7 days —922 " " " "
21 days—1112 " " " "

Coefficient of Thermal Expansion

The following results have been reported by Cornell University. The range in temperatures was from temperature to below freezing.

Mix	Inches per square inch per degree F.
1:1	.00000564
1:3	.00000551
1:5	.00000523
1:1½:3	.000005210
1:2:4	.000005155
1:2½:5	.000004823

Effect of Bond Between Lumnite Cement and Portland Cement

The Michigan Engineering Experiment Station have reported the following results obtained from tests made to determine the strength of bond between Lumnite cement and portland cement concretes. Specimens were made in the form of 6-inch cylinders and tested in shear. The cutting planes of the shear machine were spaced three inches apart, and to make the planes of the bond between the Lumnite and portland cement concrete coincide with the shearing planes of the machine for double shear, the center portions of the cylinders were first cast in forms 3 inches long by 6 inches in diameter. The desired condition of the surface was produced on these center portions. The portland cement concrete portions were cured from five to five and one-half months. Five to seven days were allowed for the curing of the Lumnite cement concrete.

Type of Test	Average Strength in Shear of Bond lbs. per sq. in.
3-inch Portland Cement concrete centers with Lumnite concrete ends. Rough pebble-keyed surface, 6-inch cyl. in double shear	350
3-inch Portland Cement concrete centers with Lumnite concrete ends. Smooth floated surfaces, acid washed, 6-inch cyl. in double shear	240
5 mos. old Portland Cement concrete centers, 4 mos. old P. C. concrete ends. Rough pebble-keyed surfaces, 6-inch in double shear	195
5 mos. old P. C. concrete centers, 4 mos. old P. C. concrete ends. Smooth floated surfaces 6-inch cyl. in double shear	195
P. C. concrete base, Lumnite cement concrete ends. Bush hammered surface, 6-inch cyl. in single shear	465
Monolithic 6x12-inch concrete cylinders	
Lumnite in double shear	700
Portland	515

The following results have been reported by Columbia University. Tests were made on 4x4x18-inch beams made of 1:2:4 concrete. Specimens were tested transversely, and the results are reported as modulus of rupture in pounds per square inch:

Cement	Surface at Joint	Modulus of Rupture
Lumnite and Portland	Rough	398
Lumnite and Portland	Smooth	238
All Lumnite	No Joint	953
All Portland	No Joint	456

Specimens were made by breaking under a transverse load at twenty-eight days a 4x4x18-inch portland cement concrete beam. One-half the length of each beam was then replaced in a mold and the mold filled with Lumnite cement concrete so that approximately one-half of the beam was portland cement concrete and the other half Lumnite cement concrete. Specimens were then tested when the portland cement concrete was fifty-six days old.

Excellent Talks and Attendance at Iowa Products Meeting

According to reports, an excellent meeting was held at Cedar Rapids, Iowa, by the Iowa Concrete Products Association on March 3 and 4.

A demonstration on the application of portland cement stucco in color and textures by Irvin Kirkpatrick of the Portland Cement Association held much interest. The demonstration was held immediately after the annual banquet and was witnessed by a number of architects, plasterers, building material dealers, as well as by the concrete products manufacturers present. The latter were particularly enthusiastic about the possibilities of portland cement stucco in color and textures as a means of getting concrete block used in the walls of homes and other structures. A growing interest locally is anticipated in concrete products as a result of the demonstration.

Mr. W. D. M. Allan of the Chicago office of the Portland Cement Association, was the principal speaker on Thursday afternoon's program. His talk centered around "More Aggressive Methods in the Marketing of Concrete Products," and aroused considerable discussion and comment. Mr. Allan stated that vigorous competition is in store for concrete products.

The following officers were elected for 1927: Floyd Goodrich, Waterloo Concrete Corporation, Waterloo, President; Geo. T. Wilhelm, Castone Products Co., Cedar Rapids, Vice-President, and R. L. Gavin, Secretary-treasurer. Members voted to hold the 1928 meeting in Waterloo, at a date to be announced later.

Methods Used in Maine for Incorporating Calcium Chloride in Concrete Mix

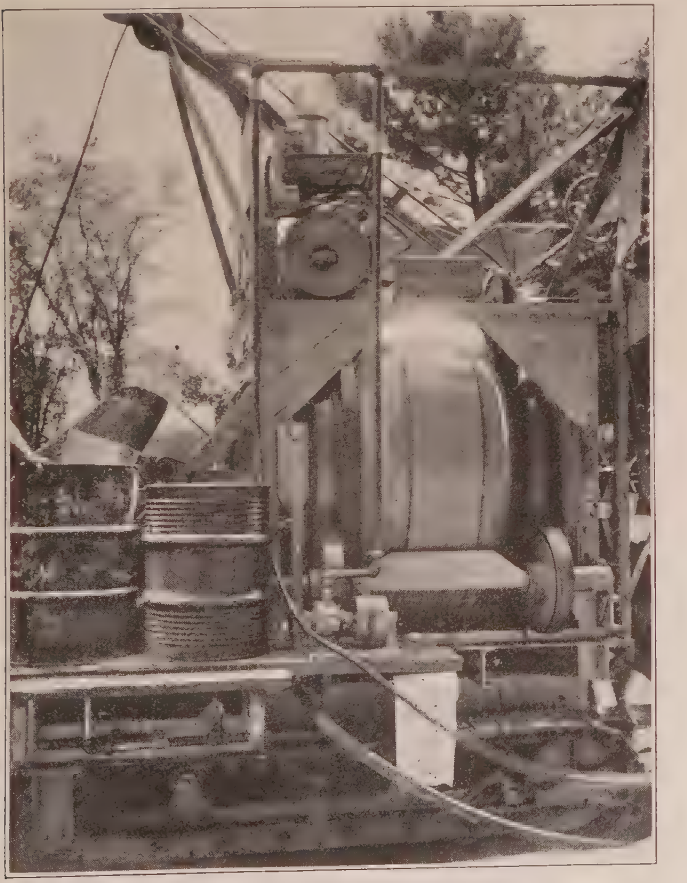
A Practical, Easily Installed Method of Incorporating Calcium Chloride in Concrete Mixes—Description of Equipment Used

By L. D. BARROWS
Assistant Engineer, Maine Highway Commission

THE increasing interest in the use of calcium chloride as a curing agent for concrete pavements led the Maine Highway Commission to study the method for proper incorporation of the calcium chloride solution with the concrete mix. In order to insure proper curing by incorporating calcium chloride, a definite amount of the calcium solution must be added to each batch of concrete. This is done in some cases by simply dumping the proper amount of solution with a pail into the drum of the mixer. The assurance that the accurate amount is added and at the proper time is placed entirely upon the operator. To eliminate this personal element, a machine has been devised which automatically pumps and measures the solution, discharging the measured amount at the proper time after the concrete materials have been dumped into the mixer drum.

Equipment Used

The equipment consists of a mixing and pumping unit and a measuring unit. Two barrels compose the mixing unit, one of which is used to mix the solution while a similar solution is being pumped from the other into the measuring tank from which it is discharged into the water line leading into the mixer drum. A fifty-gallon barrel should be filled about three-quarters full of water to which should be added 200 lbs. (2 bags) of calcium chloride and stirred until all the calcium chloride is dissolved. Enough additional water should then be added to fill the fifty-gallon barrel and the liquid stirred to make the solution uniform. The pump operates continuously from a moving shaft of the mixer, the liquid overflowing from the measuring tank into the barrel from which the solution is being pumped.



A photograph showing the equipment described installed on a mixer in the field

A three-way discharge valve is controlled by the skip lever so that the solution is added in proportion to the amount of cement, and at the same time as the water is being discharged into the drum. When the valve is opened for discharge from the measuring tank the intake is closed and the liquid is passed through the bypass so as to allow the continuous pumping operation. A glass gauge is placed on the measuring tank so that easy observation may be made of the operation.

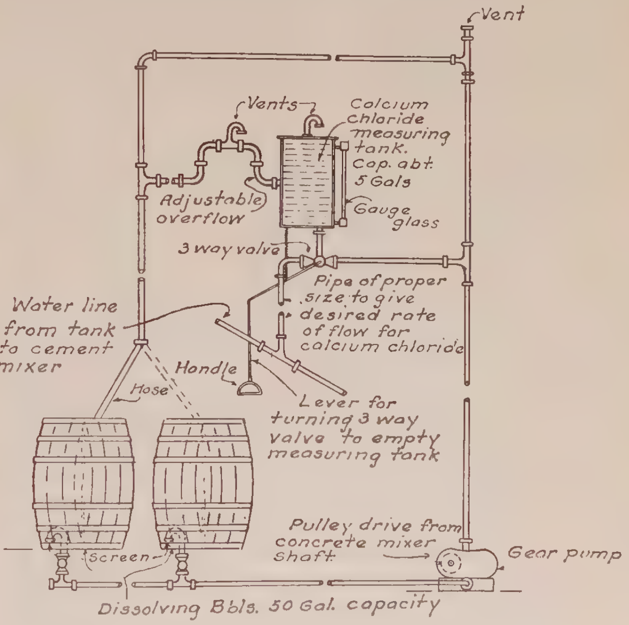

Vent
Vents
Calcium chloride measuring tank. Cap. abt. 5 Gals
Adjustable overflow
Gauge glass
3 way valve
Pipe of proper size to give desired rate of flow for calcium chloride
Water line from tank to cement mixer
Handle
Hose
Lever for turning 3 way valve to empty measuring tank
Pulley drive from concrete mixer shaft
Gear pump
Screen
Dissolving Bbls. 50 Gal. capacity

Diagram showing method of arranging the equipment

Empty oil barrels may be used for the mixing tanks, cutting out the plain end and installing the pipe in the fittings found in the other end of the barrel. A small gear pump is satisfactory for lifting the solution to the measuring tank and may be run from any shaft of the mixer or by a belt encircling the drum.

Precautions

Care must be taken to keep the solution clean and free from small hard grains, as sand, or difficulty may be encountered with the pump. To guard against this a short piece of pipe should be run up inside the barrel with a U-nipple having the end covered with a screen. Covers should be provided for these barrels to assist in keeping the solution clean. Standard 1¼-inch pipe is satisfactory for intake into the measuring tank. The outlet should be of a size that the required quantity of calcium chloride solution will empty in the same time as the tank of mixing water.

The accompanying drawing shows how this apparatus may be used with any type of mixer and the photograph shows the apparatus as placed, under the supervision of The Solvay Process Co., on a new Multi-Foote mixer, by the McCormick Construction Co. at South Paris, Maine.

With this apparatus the calcium chloride solution is definitely discharged into the mixer drum at the same time with the water without the mixer operator being required to give any special attention.

Proper inspection is easily carried on. The strength of the solution may be checked by the use of a hydrometer. The measuring tank may be calibrated. It may be easily determined by observing through the glass gauge that the solution rises in the measuring tank in short enough time to insure the full quantity of calcium chloride for each batch.

This method not only insures the proper incorporation of the calcium chloride solution, and therefore uniform curing of the concrete, but is labor saving as it requires but one man to carry on the curing. No covering or other curing is needed except during the summer months, when wetted burlap should be placed immediately on the concrete.

Adopt Intermediate Grade of Steel as Single Standard for Reinforcement

The current intermediate grade of the American Society for Testing Materials was adopted as the single standard grade of new billet stock for concrete reinforcement at a general conference held at the Department of Commerce March 18 under the auspices of the National Committee on Metals Utilization. The conference was attended by 50 representatives of manufacturers, distributors, consumers and engineers interested in steel reinforcement for concrete. W. Chattin Wetherill, director of the Metals Utilization Committee, presided.

A. E. Lindau, chairman of the Grade of Steel Committee which conducted a survey of present practice during the past year presented the committee's report. It was the sense of the meeting that a single grade of new billet stock is desirable for concrete reinforcement. The discussion that followed developed the fact that the bulk of the demand is concentrated in the intermediate grade, and the conference adopted this grade, consequently, as standard for a period of one year. At the end of that time a similar general conference will be held to discuss the success of the standardization project.

Use of Early Strength Concrete

Early strength concrete has been put into use officially on King County, Washington, roads recently in the paving of two highway gaps near Renton, according to a statement by King County Engineer Don Evans.

Traffic was permitted over the surface seven days after pouring. The mix used on the two county jobs considered was a 1:1.67:2.05.

Varied Angles of Products Business Discussed in Northwest

Technical problems relating to the concrete products industry concerned the membership of the Northwest Concrete Products Association during its two-day session in Seattle, Washington, held in connection with the second annual convention of that organization. The meeting was attended by 75 association members from all parts of the Pacific Northwest.

Seattle's woman mayor, Mrs. Bertha K. Landes, greeted the visitors. W. H. Mackenzie, Portland, responded to Mayor Landes' welcome.

An extensive discussion of the three methods of lessening the disintegration of concrete was given by Dr. H. K. Benson, professor of chemical engineering, University of Washington. The elimination of voids, the use of bituminous type coating and the integral method were explained in detail. Dr. Benson stated that his experiments had shown that the integral method combined with two coats of bituminous coating is the most satisfactory. He stated, however, that this method would, undoubtedly, prove too expensive for general use at the present time.

Harlan Thomas, president of the Washington state chapter of the American Institute of Architects, talked on concrete products from the architect's viewpoint. He stated that architects were willing to co-operate with products men wherever possible, but he also urged manufacturers to remember that the architect must consider absolute suitability of materials as well as their cost and durability. Mr. Thomas stated that the wrecking of concrete buildings to make room for newer structures was now an expensive job and a subject that might well come in for serious study by concrete products men.

H. A. Ambler, of Superior Portland Cement, Inc., talked on three-day concrete and designing of mix. Ira L. Collier of the University of Washington gave a resume of laboratory tests with regard to concrete products made by his department during the last year. C. P. Bates, Arcade Square Insurance Company, Seattle, discussed insurance as relating to the concrete industry.

The organization now numbers 41 members, according to J. R. Sherman, Yakima, of the membership committee.

The business sessions of the meeting allowed for general discussion following the papers. A banquet and entertainment was provided for the membership on the evening following the first day's meeting. After the business session on the second day the membership was taken for a tour of the Pacific Stone Company of Seattle and the Concrete Structural Units Company plants.

A. J. R. Curtis, assistant to the general manager of the Portland Cement Association, Chicago, addressed the second-day session. He urged those engaged in the concrete industry to form more intimate contacts with architects, construction men, and others in allied industries.

A discussion of the discrimination of insurance companies against the concrete industry followed.

J. A. Fallgreen, city engineer, Auburn, talked on concrete products from the engineer's viewpoint. Minor Meriwether, Concrete Structural Units Co., Seattle, discussed hollow concrete masonry units. Cost accounting was the subject of a talk by Earl Bracken, Grays Harbor Cement Products Company, Aberdeen.

Officers elected were as follows: President, W. H. Sharp, Longview; first vice-president, E. V. Bull, Ontario, Oregon; second vice-president, Hans Mumm, Jr., Everett; third vice-president, J. R. Newell, Spokane; secretary-treasurer, J. J. Collins, Portland; executive secretary, J. R. Zaugg, Seattle.

Strength Tests of Sand for Concrete Work

The Relation of Compressive to Tensile Tests of Sands at Seven and Twenty-eight Days

By M. A. DURLAND

THE American Society for Testing Materials defines sand in their Tentative Standards 1925, as "The fine granular material resulting from the natural disintegration or the crushing of rock or slag." As usually considered it is that part of the fine aggregate which passes a sieve having four meshes per linear inch. The sand is an important element of a given concrete and may have considerable influence on the final strength which the concrete will attain. Consequently, it has been thought necessary to make strength tests of the various sands which might be used in any certain concrete work.

At present, practically all strength tests of sand are made by comparing a 1 to 3 mix (by weight), using the sample sand, with a similar mortar using standard Ottawa sand. Since there may be considerable difference in the results obtained when using the sand in a mortar and when using it in a concrete this is not an altogether satisfactory method of testing. Its convenience and simplicity have been considered sufficient, however, to justify its continued use.

Variations in Testing Methods

Although sand tests are quite commonly made on a 1 to 3 (by weight) mortar mix there is no general agreement as to whether they should be made in tension or in compression. Even state highway specifications which are more or less standardized do not agree upon this point. The most common requirement at the present time is that the sand tested shall have a tensile strength at 7 and at 28 days equal to or greater than that of a similar mortar made at the same time using standard sand. Some highway laboratories are testing using a 1-3 (by volume) mix which in certain cases will give a very different result than the more usual method, by weight. Some laboratories test on the basis of compression and some even use other than a 1 to 3 mix.

The specifications under which the Kansas laboratory has been testing are as follows: "Mortar briquettes, cylinders or prisms consisting of one part by weight of portland cement and three parts by weight of fine aggregate mixed and tested in accordance with the methods described in the Standard Specifications and Tests for Portland Cement (Serial Designation: C-9) of the American Society for Testing Materials, shall show a tensile or compressive strength at the age of 7 and 28 days not less than that of 1 to 3 standard Ottawa sand mortar of the same consistency made with the same cement."

Figure 1 shows the results of 674 tensile tests of sand. The ratio of the tensile strength of 1 to 3 (by weight) mortar briquettes made with the sample sand to the tensile strength of similar briquettes made with standard Ottawa sand is shown at 7 and 28 days. The dotted line is drawn through the means of the columns and the solid one is the best fit for the whole distribution as computed by the theory of least squares. Two things are shown in this figure that are worthy of consideration. First, a relatively large proportion of the sands tested (46 per cent) fails to meet the requirements at either 7 days or 28 days. Second, the straight line which represents the most probable relation between the 7 and 28 day strength ratios indicates that a 7 day strength ratio of over 0.90 is likely to be accompanied by a smaller one at 28 days.

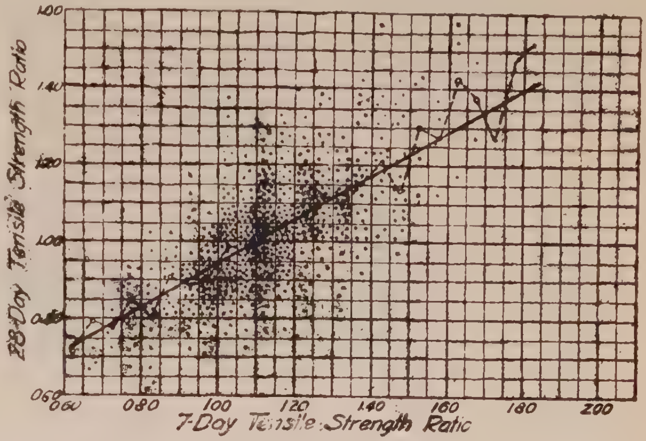


Figure 1

Compressive Tests

The same characteristics of sand that make for high tensile strength do not always give high compressive strength and vice versa. Since the sand when used in concrete is subject chiefly to compressive stresses it is probable that a compressive test is a better criterion of the value of a sand than a tensile test. On this basis, recent tests in the Kansas Road Materials Testing Laboratory have been made in compression.

Figure 2 shows the results of 215 compressive tests of sand. The dotted line is drawn through the means of the columns while the solid line is the "least square" line. Figures 1 and 2 indicate that the relation between the 7 and 28 day strength ratios both in tension and compression may be expressed by a linear equation.

The fact that a relatively small number of samples fail to meet the requirements at 7 or 28 days does not necessarily have any significance in relation to Figure 1, since the compressive tests are generally of more recent date and possibly do not cover the same range of sands. It should be noted however from the solid line in Figure 2 that ratios of less than 1.20 at 7 days are likely to be accompanied by higher ratios at 28 days.

Further light is thrown upon the relation of compressive to tensile test results by a series of parallel tests upon 50 representative samples of Kansas sand. The results of these tests are shown in Figures 3 and 4. The forty-five degree line drawn in each figure is the line about which the results should be equally grouped if the tensile and compressive ratios were similar. Both figures show quite conclusively that Kansas sands at least are almost certain to give higher ratios in compression than in tension.

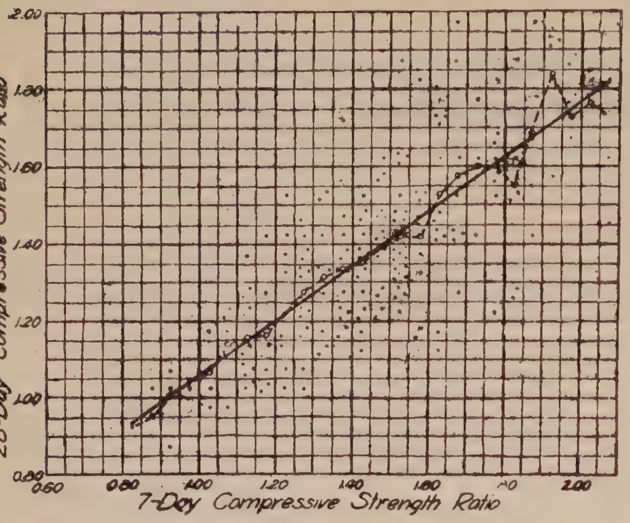


Figure 2

Strength tests of sand do not furnish very definite information as to its value in concrete but it is quite likely that such tests will be retained, for the present at least.

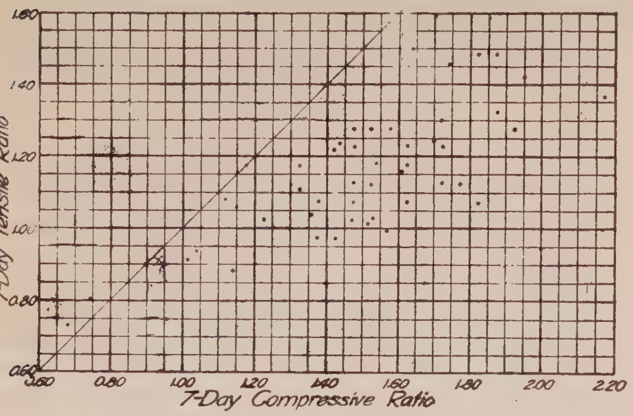


Figure 3

Since such is the case it would seem quite desirable that we should know more about what we are testing for and as to whether or not our standards are properly set.

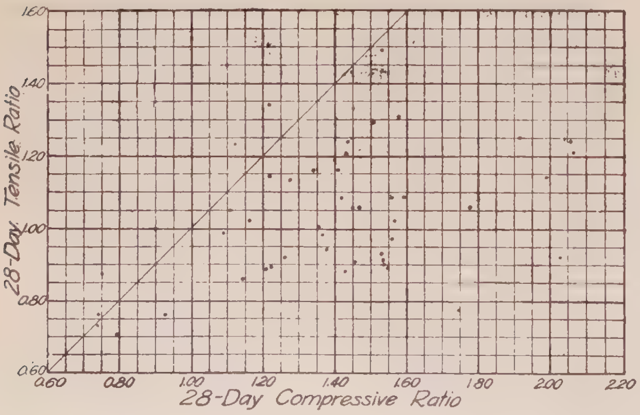


Figure 4

Duff Abrams Resigns as Director of Research Laboratory

The Portland Cement Association announces with regret the resignation of Duff A. Abrams, for many years Director of the Research Laboratory. Professor Abrams inaugurated the present-day research in concrete when he took charge of the Structural Materials Research Laboratory in 1916. The research program, then begun, was supported by cooperation of Lewis Institute and Portland Cement Association. This joint arrangement continued until May, 1926, when the Research Laboratory was installed in the new headquarters building of the Portland Cement Association at 33 West Grand Avenue, Chicago.

Professors Abrams' work in concrete research is internationally known. His bulletins and scientific papers have been translated into many languages and are standard reference works in concrete technology.

Prior to his connection with Lewis Institute, Professor Abrams was a member of the faculty staff of the University of Illinois, of which he is a graduate.

F. R. McMillan, Manager, Structural and Technical Bureau, Portland Cement Association, has been appointed Director of Research to have charge of all investigations in cement and concrete for the Portland Cement Association. Mr. McMillan has been a member of the headquarters and laboratory staffs since April, 1924. Prior to that time, for three years he was Associate Structural Engineer with Adolph F. Myer, Consulting Hydraulic Engineer of Minneapolis. He was also on the staff of the Turner Construction Company for some time and was in charge of concrete ship design for the Emergency Fleet Corporation, United States Shipping Board, during and subsequent to the war. For nine years Mr. McMillan was on the faculty staff of the University of Minnesota in charge of concrete design in the concrete laboratory. He is a graduate of the University of Minnesota.

H. F. Gonnerman, Associate Engineer, Research Laboratory, Portland Cement Association has been appointed Director of the laboratory. Professor Gonnerman joined the staff of the laboratory in 1922. Prior to that time he was in a private business in the far West and from 1908 to 1920 was on the faculty staff at the University of Illinois, of which he is a graduate. Professor Gonnerman is joint author of many of the Research Laboratory bulletins and while on the faculty staff at the University wrote a number of technical and scientific papers which received wide attention in engineering and technical circles. For many years he has been active in the American Society for Testing Materials and other technical and engineering societies.

Permanent Exhibit of Building Materials in Chicago

Chicago's permanent building materials and equipment exposition, to be housed in the Builders' Building, now nearing completion on double-decked Wacker Drive, will be opened to the public on May 1.

The second and third floors of the building, surrounding and overlooking the rotunda, with a floor area of more than 47,000 square feet, are being combined into exposition space, with building materials on the second floor and building equipment on the third floor.

New Equipment

Addition to Sure Grip Line of Shores

An entirely new type of adjustable shore has been designed and perfected by the Dayton Sure Grip & Shore Co., of Dayton, Ohio.

Distinctive features of the Sure Grip shore are its speed in operation and adjusting, claimed to require but ten seconds, and its automatic and positive pin adjustments that cannot slip or settle under load.

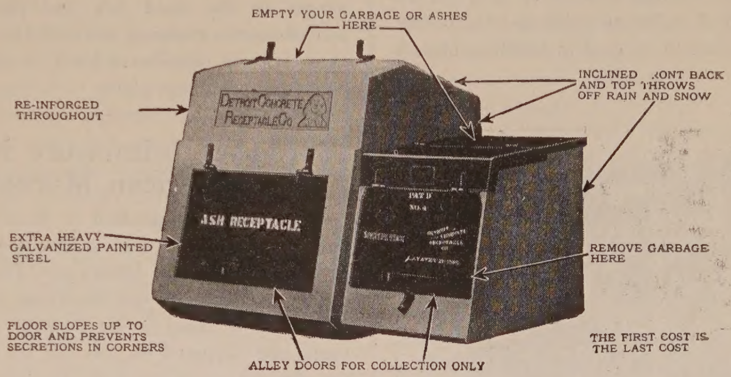
Each shore is equipped with individual jack, requiring no loose tools of any description for its operation. The entire shore, both wood and iron parts, is completely painted, reducing depreciation to a minimum. Standard size has a range of adjustment from 8 feet to 14 feet, and weighs but 55 pounds.

Market Analyzed Previous to Purchase of Mold

That concrete garbage boxes are preferred because they are cleanlier and are an improvement, rather than a detraction from the appearance of the surroundings, has become evident in almost every community.

Detroit, Michigan, has such a box manufacturer, the Detroit Concrete Receptacle Company, who is selling the boxes very successfully locally, and the forms for their manufacture nationally. The receptacle provides a separate compartment for garbage and for ashes, the latter being about one-third higher in size. Different sizes are provided for each, depending upon the number of families making use of the box.

A service that the products manufacturer will greatly appreciate, particularly if the concrete garbage box idea is new in his territory, is the market analysis made for him by the Detroit Concrete Receptacle Company. If the report is favorable and the manufacturer begins production, frequent proven merchandising ideas and helps are provided.

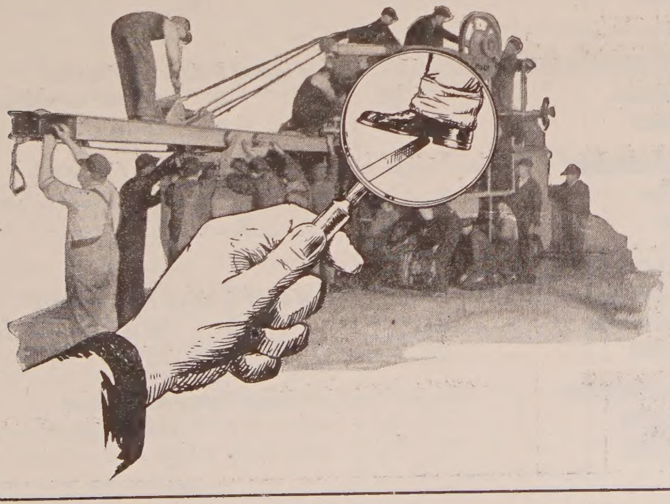

EMPTY YOUR GARBAGE OR ASHES HERE
INCLINED FRONT BACK AND TOP THROWS OFF RAIN AND SNOW
RE-INFORCED THROUGHOUT
DETROIT CONCRETE RECEPTACLE CO
ASH RECEPTACLE
EXTRA HEAVY GALVANIZED PAINTED STEEL
REMOVE GARBAGE HERE
FLOOR SLOPES UP TO DOOR AND PREVENTS SECRETIONS IN CORNERS
THE FIRST COST IS THE LAST COST
ALLEY DOORS FOR COLLECTION ONLY

Centralized Lubrication Introduced to the Paving Field

Instant, central lubrication from the operator's platform has recently been installed as standard equipment on the Smith 27-E six bag paver which enables the operator, by simply pressing a lever with his toe, to force lubrication simultaneously to the bearing surfaces in the machine.

Such a system is decidedly new for pavers—insures perfect and consistent lubrication, but encourages frequent attention on the part of the operator.

Engineers feel that the installation of the system on the Smith 27-E will give smoother action and greater dependability.



New Tile Machine for Light-Weight Unit

A tile machine producing light masonry units of 18 to 20 pounds, designed to achieve maximum strength with minimum web section, has been developed by the Anchor Concrete Machinery Company, Adrian, Michigan, and placed on the market. The unit bulks large in the wall and has strength enough to support several times over the weight ever demanded of it.

The machine produces four tile at a time, of any standard design.

"D & R" Metal Forms for Concrete Joist Floors

A system of removable metal forms for concrete joist floors that is reliably grout-tight and has proven successful in its four years on the market is the "D & R" type. Repeated use of the forms on one job can be made since they may be removed within twenty-four hours, in warm weather, without disturbing the wood shoring supporting the joists. A patented type of end cap bolted into the end form permits the removal of the end form without bending it out of shape.

After joists are erected and separators placed in position and laid loosely, the forms are placed, the ends first, with the adjoining forms overlapping about four inches. The soffit planks are then dropped between the rows of metal forms and wedged tightly in place.

In removing forms, the separator strips are knocked out of position, the forms grasped and collapsed inwardly, when they drop out.

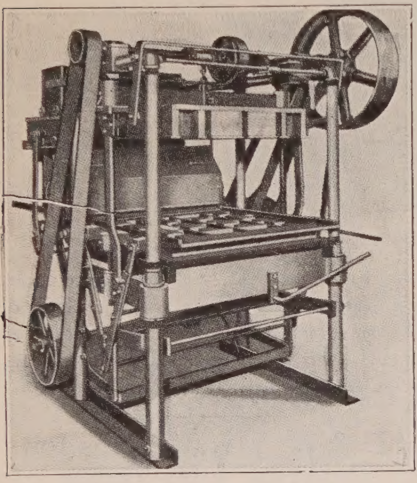
All forms are 3-feet long and 10 or 14 feet deep, and may be secured from the National Concrete Metal Forms Corporation, New York City.

New Equipment

H-Shaped Brick Produced in Two Sizes

Machine Greatly Improved

A brick machine bringing forth several improvements is now available for the manufacture of H-shaped brick. The Haydenite brick machine produces brick in three different sizes—two of the shape of the letter "H" and one of the standard shape. The large H-shaped brick is 12½ inches in length, 8 inches in width and 2¼ inches in thickness, to be used in building 13-inch walls.



The smaller H-shaped brick is the same width and thickness but is only 8 inches long, for 9-inch walls. One face is corrugated and the other is plain.

The standard brick is 8 inches long, 3¾ inches wide and 2½ inches thick—the U. S. Government standard. One side and one end are corrugated.

Twenty-seven thousand common brick or an equivalent of about one-third of that amount of H-shaped units are possible per nine-hour day, with but one man at the machine. An extremely wet mix may be used, making a very dense brick. An automatic feed and a mechanical apparatus for removing surplus material are labor-saving devices. Wooden pallets are used.

The brick may be colored, and providing genuine mineral oxide colors are used, the brick will not fade or deteriorate.

The Haydenite Brick & Machinery Company, 1417 Chemical Building, St. Louis, Missouri, is the manufacturer of machines producing H-shaped brick.

Manhole Block Made on Anchor Inverted Stripper

For producing catch-basin and manhole block, the Anchor Concrete Machinery Company inverted stripper has been found useful. It operates under any four-, five- or six-drop Anchor Floor Type or Suspended Type tamper, when furnished with proper tamp feet.

A facing feeder is another new addition to the Anchor family. When the pallet is placed in the mold box and the mold turned over to tamping position, the facing automatically distributes itself in an even layer over the face plate.

Mixing Box and Tubular Edge Pallet New Products

The Commercial Shearing and Stamping Company, Youngstown, Ohio, has completed improvements on steel products of interest to the products manufacturer and the contractor. For the latter, there is the "Commercial" all-weather and all-steel mixing box, of heavy blue annealed sheet steel, with welded joints, and no bolts or cleats.

A welcome should be in store for the newly developed rolled corner brick pallet that cannot twist or bend. It is made of one piece of steel and has a continuous tubular edge.

European Admixture Now on American Market

An admixture originated in Europe during the war, that has a decided acid-proofing power, and known as "Fluresit," is now available on the American market. Fluresit is received in the form of a thick paste and prepared on the job by mixing the desired quantity with its weight in water.

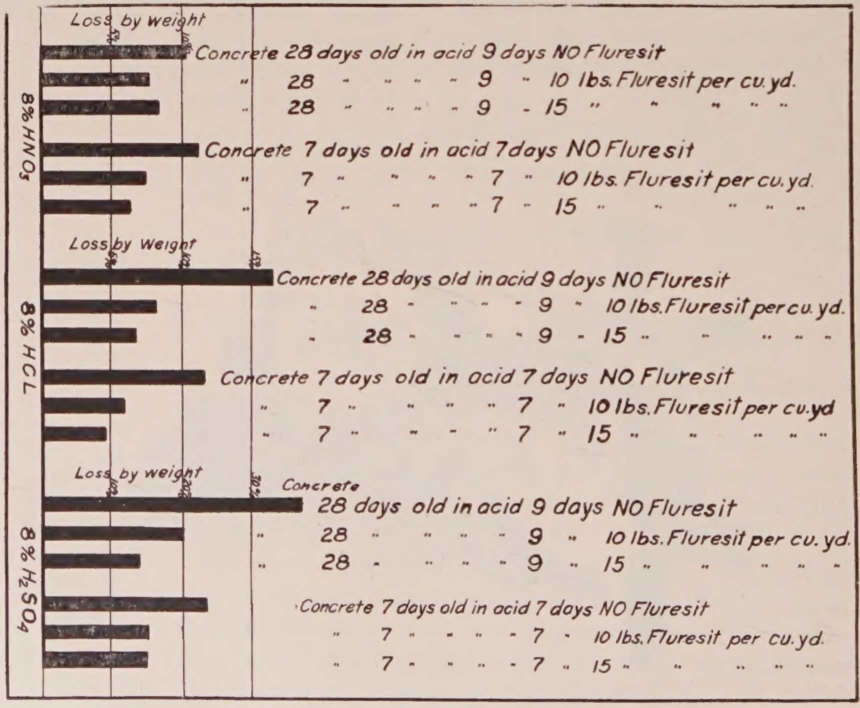
For waterproofing and providing acid-resisting concrete, ten pounds of Fluresit are used to the cubic yard. Fifteen pounds of the admixture per cubic yard in a 1:3 sand mortar produce a watertight mortar for laying up masonry walls or repairing leaky surfaces.

In a sixty-day compression test on 6x12 cylinders made by the H. C. Nutting Co., Cincinnati, Ohio, using a 1:3 mortar of portland cement and standard Ottawa sand, an average strength of 3465½ lbs. per square inch was obtained from cylinders in which Fluresit was used and 1634½ lbs. from no-admixture cylinders.

Results of acid tests are shown.

Fluresit is manufactured and sold by the American Fluresit Company, 27 East Water Street, Cincinnati, Ohio.

Territorial rights have been taken over by Mr. J. A. Dunn of the Chicago Fluresit Company, at 139 North Clark Street, Chicago, Ill.



With the Manufacturers

Industrial Literature

Traprock Available

Announcement of the availability, in the Great Lakes territory, of a supply of trap rock, is made in a booklet published by *Clement K. Quinn & Co.*, agents for the Quinn Stone and Ore Co., Ltd., with offices at Duluth, Minnesota, Fort William, Ontario, and Cleveland, Ohio.

Stucco Recommendations

"*Stucco Investigations at the Bureau of Standards*" is the title of the Department of Commerce publication No. 311, containing recommendations for portland cement stucco construction.

Helpful Booklet

"The Cal Book," published by the *North American Cement Corporation*, Hagerstown, Maryland, is an excellent booklet covering the use of the admixture. Charts, tables, as well as photographs, furnish the illustrations.

House Plans in Catalog

A photographic plan section is an interesting part of the *Miles concrete products equipment catalog No. 312*. This section shows plans and exterior illustrations of concrete block houses and other structures, and was designed by the *Miles Manufacturing Company*, Jackson, Michigan, as a prospectus for home builders.

Cinder Block Absorption

The results of two investigations made by the University of Toronto and the Detroit Testing Laboratory on the sound absorption of cinder concrete building units are made known in a booklet published by the Engineering Department of the National Building Units Corporation. Subjects covered include acoustics of auditoriums, partition walls, transmission and reflection, and a table of sound absorption coefficients.

Arc Welding Textbook

"*Arc Welding, the New Age in Iron and Steel,*" is the name of a new 160-page textbook recently published by the *Lincoln Electric Company*, Cleveland, Ohio, and is a comprehensive treatment of the subject.

The book is devoted largely to the use of arc welding in general production manufacturing. It contains more than 200 illustrations, chiefly of products of representative manufacturers which have been manufactured by arc welding.

Notes from the Field

A Larger Wire Rope Plant

With the purchase of the Cochran interests in the Williamsport Wire Rope Company of Williamsport, Pa., by a syndicate headed by Robert Gilmore, Edgar Munson, Logan Cunningham and C. M. Ballard, the control of this industry virtually passes into the hands of old employees who put into immediate action the building of what is expected to be the biggest wire rope plant in America.

Robert Gilmore, president, continues as the directing head, having been actively associated with the company for 34 years. Edgar Munson becomes vice-president and treasurer. Logan Cunningham becomes vice-president and secretary and C. M. Ballard, vice-president and general sales manager.

No time is being lost by the new organization in putting into effect one of the most progressive programs of their career, for the task of enlarging the present mammoth plant and the extension of present facilities has already begun. The Williamsport *Gazette-Bulletin* says:

"One new building will be 450 by 200 feet and will be equipped with the most modern labor-saving devices. Together with the present and the other building it will make the Williamsport plant the largest plant in the country devoted exclusively to the manufacture of wire rope.

"The new buildings will enable the company to add several hundred men to its present force which is now being worked on day and night shifts in order to keep pace with the volume of orders which more than tax the present facilities.

"The Williamsport Wire Rope Company was organized in 1887 and has grown steadily until it is even now among the largest in the country. It has warehouses and branches in practically every state and also has a large export business."

Duntile Manufacturers

E. A. Hoselton, of Orlando, Florida, has been named president of the *Duntile Corporation of Florida*, a consolidation capitalized at $500,000 and composed of Duntile plants in twenty-five cities throughout Florida.

Other officers elected were A. D. Cranston, of Lake Worth; first vice-president, A. Humphrey, of Tampa; second vice-president, E. H. Lasseter, secretary, and J. W. Sage, treasurer.

Reinforcing Institute Engineer

Richard W. Johnson has been appointed by the *Concrete Reinforcing Steel Institute*, to develop its promotional work and the use of reinforced concrete construction. Mr. Johnson, a West Point graduate, was, until recently, in the Indianapolis office of the Portland Cement Association.

Rex Changes

W. H. Brandt, advertising manager of *Chain Belt Company*, has been appointed assistant secretary, succeeding George M. Dyke, who has gone to Cleveland to assume the duties of secretary of the Stearns Conveyor Company, now owned by Chain Belt Company. A. R. Abelt is now advertising manager.

Rejoins Koehring

Mr. K. H. Talbot has rejoined the *Koehring Company*, Milwaukee, Wisconsin, as Director of Sales. For five years, from 1919 to 1924, he acted as manager of field service, leaving this position to join the *Cowham Engineering Company*, Chicago.

Smith Distributors

The T. L. Smith Company of Milwaukee, manufacturers of Smith mixers and pavers, have recently announced the appointment of John McNeilly, 335 South High Street, Columbus, Ohio, as distributor in that territory.

The New Mexico Road Machinery Company, of Albuquerque, New Mexico, have also recently been appointed as Smith distributors.

Lincoln Representatives

G. N. Bull, formerly with the *Worthington Pump & Machinery Company* in their Washington, D. C., office, has been made District Manager of the New York office of the *Lincoln Electric Company*.

C. S. Freeman, formerly in charge of the Lancaster office, has been transferred to the Buffalo office and made District Manager.

S. W. Shultz, formerly of the Philadelphia office, has been put in charge of the Lancaster office.

Ed. J. Pfister, formerly of the Buffalo office, has been transferred to the Philadelphia office.

Mixer Musings

Reported by "Joe"—The Mixer Boss.

News of the Guild of Certified Slump Testers

APPLICATIONS for membership in the ***Guild of Certified Slump Testers*** are being received in the offices of the Keeper of the Records. Each applicant, as soon as his application is acted upon by the Committee on Members, is notified of his election. Up to the present time the Keeper of the Records has not received blank copies of the Certificates conferring the *Degree of Certified Slump Tester,* but as soon as they are on hand, they will be duly inscribed and sent to those applicants who have been accorded membership in the Guild.

Not long ago the Committee on Ways and Means sat in earnest session confronted with the problem of designing a suitable coat of arms for the Guild. Also it was necessary to choose a motto, a Diety, etc. Work on the coat of arms is progressing. It is hoped that the design can be presented in next month's news.

As for a slogan, what can be more proper than this—"Watch Ye The Water Barrel." The Diety of the organization can, of course, be none other than Neptune, the God of the Waters. However, these are only suggestions and if any member or anyone aspiring to membership has any suggestions to make, the Committee will be glad to have them.

Undoubtedly there are still many slump testers abroad in the land who have not yet made application for membership in the Guild. Perhaps some of them failed to see the announcement in last month's Mixer Musings and, for their benefit, we are summarizing the fundamental facts about this most unique organization.

ONE of the purposes of the ***Guild of Certified Slump Testers*** is to collect and record all these epoch-making experiences so that they may go down in the record for the benefit of posterity. Another purpose is to accord, in some measure at least, honor to those who have labored and perspired in the cause of better concrete. To that end the Guild will confer upon each and every duly accredited member the *Degree of Certified Slump Tester* and as a concrete manifestation of this high honor, it will present every member with a Certificate conferring the degree.

All Slump Testers, even though they have made only one test in the course of their career, are eligible for membership. All that is required is that every Slump Tester aspiring to membership in the Guild, write his or her experiences in making his or her first slump test and then send that record of outstanding accomplishment to Joe, the Mixer Boss, 21st floor, 139 North Clark St., Chicago. The Committee on Members will pass upon this document. If, in the opinion of the Committee, the applicant appears to appreciate the honor that is about to be bestowed upon him and the record of the first slump test appears authentic and correct according to Abrams (we almost said, according to Hoyle) then that applicant will be admitted into the charmed circle of the Guild. The rights, privileges and immunities that pertain to membership will be conferred upon the applicant when his Certificate is forwarded.

Let it be reiterated—membership in the Guild does not mean anything but—it is darn exclusive!

Joe, the Mixer Boss.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 West Thirty-ninth St., New York City.

American Road Builders' Association; Wm. H. Connell, President, Miss E. A. Birchland, Secretary, 29 W. 39th St., New York City.

American Society for Testing Materials, C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer Secretary, 1150 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; 123 West Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference: H. E. Plummer, President, J. F. Downey, City Hall, Cambridge, Mass., Secretary.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Concrete Products Association; S. I. Crew, Cincinnati, Ohio; D. R. Collins, Secretary, 47th and State Streets, Alois Postoffice, Milwaukee, Wis.

Iowa Concrete Products Association; Floyd Goodrich, President; R. L. Gavin, Secretary-Treasurer, 405 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. E. Coleman, President, 37th St. & Stewart Ave., Chicago. A. W. Dickson, Executive Secretary, 214 Electric Bldg., Cleveland, Ohio.

National Association of Builders' Exchanges; William F. Chew, Baltimore, President; Earl F. Stokes, Secretary, 15 East Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East Twenty-second St., New York City.

The National Lime Association: Burton A. Ford, Secretary, 927 15th Street, N. W., Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 933 Leader-News Building, Cleveland, Ohio.

National Sand and Gravel Association, V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

Nebraska Concrete Products Association; A. V. Anderson, President, Reimers-Kaufman Co., Lincoln, Neb.; E. L. Bateman, Secretary, Bethany, Neb.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, 111 W. Jackson Blvd., Chicago, Ill.

Wisconsin Concrete Products Association; A. P. Kuranz, Secretary-Treasurer, 425 E. Water St., Milwaukee.